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ABSTRACT

This booklet is the seventh of a series of 16 booklets that together describe and present findings for a study which involved field observations and a survey of science teaching and learning in American public schools during the school year 1976-77. The study was undertaken to provide the National Science Foundation with a portrayal of current conditions in K-12 science classrooms to help make the Foundation's programs of support for science education consistent with national needs. Eleven high schools and their feeder schools were selected to provide a diverse and balanced group of case study sites. One field researcher was assigned to each site and instructed to find out what was happening and what was felt important in science (including mathematics and social science) programs. The case study report from the "Pine City, Alabama" site is contained in this booklet. (MN)

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Case Studies in Science Education
A project for the National Science Foundation
conducted by CIRCE and CCC
270 Education Building
University of Illinois at Urbana-Champaign

BOOKLET VI

CASE STUDIES IN SCIENCE EDUCATION:

PINE CITY

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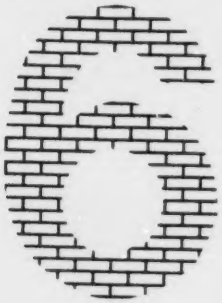
August 1977



Pine City is located in the "heart of Dixie," not far from the capital of the Confederacy. Brown vs. Topeka Board of Education (1954) has had an enormous impact on this community and its schools. "In the eyes of everyone in Pecan County," writes the observer, "integration is the key issue, perhaps particularly in the schools; but much of what is focused on education pervades the community as a whole."

The importance of leadership is clearly evident in this setting. The current superintendent spearheads a valiant effort to upgrade education and to restore a sense of community pride in and respect for public schooling. He is white; the assistant principal in the high school, an older black man, remains a pillar of stability over time. A local minister joins in their efforts from his pulpit; teachers contribute by providing myriad examples of social interaction across racial lines.

Finances are an overriding issue. Schools in the rural South possess a long history of underfunding. For generations the region supported a dual system; today, the white academies are symbolic in part of a deep-seated reluctance to finance an educational system for all the children and youth of the community. Descriptions concerning the lack of equipment in science classrooms, the constraints thereby imposed on both teachers and students, are stressed by the author.

Teachers are faced with an unrelenting need to emphasize mastery of basic English: labeling, defining, recall are common to all classes. The "learning lab," where a working knowledge of science becomes important, is found in the vocational realm, especially auto mechanics.

> Before total integration, we already had whites going to the area [trade] school. The first two years, Mr. T. [former superintendent] decided we'd use this to give the blacks somewhat of an advantage, but the whites decided they had just as much right, too. . . . So two years before we had total integration, we started busing white students into the area trade school, when it was still an all-black school.
>
> Now a good mechanic, if he's a crackerjack, it doesn't matter what color his skin is. Our two top boys from automotive were hired. One was a black and one was a white.

There is hope in Pine City and it is reflected in the observer's comments. Much work lies ahead, and the past has not been a pleasant one; but the promise of the "New South" is examined in these pages.

I've always admired those reporters who can descend on an area, talk to key people, ask key questions, take samplings of opinions, and then set them down in an orderly report very like a road map. I envy this technique and at the same time I do not trust it as a mirror of reality. I feel that there are too many realities. What I get down here is true until someone else passes that way and rearranges the world in his own style.

John Steinbeck
Travels with Charley, p. 69
Viking Press 1961

ACKNOWLEDGEMENT

Many people in Pine City were generous with their time and interest, and each contributed to this study in some way. It would take several pages to list all the people who helped us, not only in the school system, but also in the community.

It seems unfair to single out individuals, but Ben Walker thanks his kindergarten class and their teacher, all of whom he remembers with great affection. And as a family we would like to take this opportunity to thank Rachel, for she was tireless in introducing us to new places, new things and new people. Without Rachel's help this study would have been much poorer.

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CASE STUDIES IN SCIENCE EDUCATION: PINE CITY

Rob Walker

BACKGROUND

The Schools

The public school system in Pecan County includes Pine City Kindergarten, Elementary and High Schools, which together form the subject of this study. In addition, the County School Board administers the schools in Greensboro and Magnolia which are not included in the study. The superintendent, who is appointed rather than elected, does, however, have responsibility for all public schools in the county.

Enrollment in Pecan County public schools in September 1976 was as follows:

	Grade	%white	%black	Total
Pine City Kindergarten	K	38	62	236
Pine City Primary	1-3	34	66	618
Pine City Elementary	4-6	38	62	645
Pine City Junior High	7-8	37	63	500
Pine City High School	8-12	38	62	913
Magnolia School	K-12	68	32	533
Greensboro High School	1-3, 9-12	43	57	525
Greensboro Middle School	K, 4-8	42	58	429

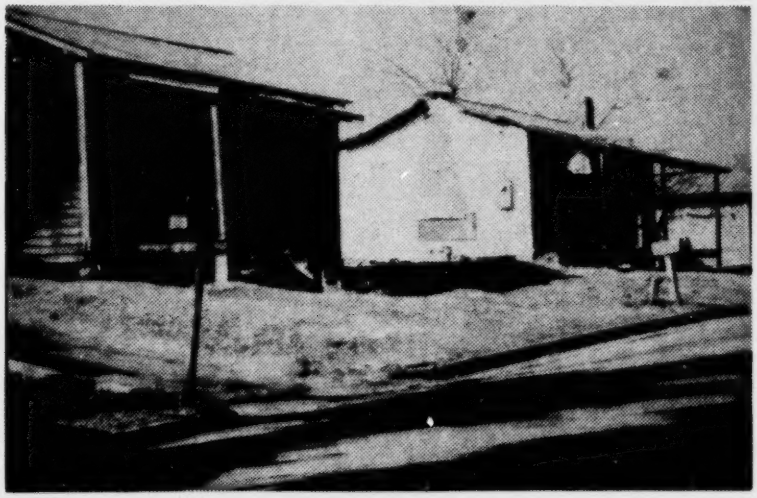
The ratio of black to white teachers in the county is about 4:6.

Characteristics of the Area

Pine City is a town of some nine thousand inhabitants in a rural part of the Deep South. In each of the last two decades the population of the city itself has grown by about one thousand, though the overall county population has remained more stable. In the past, the prosperity of the town has been linked to the railroad, which still runs through the center of town; but in the last few years its economy has been largely sustained by the interstate highway which passes just inside city limits. Economic growth has been gradual, but unlike many similar towns in the region, the presence of the interstate highway seems to have prevented recession or decline.

Seen from within the community, the shift in focus from the railroad to the highway has meant change. The new shopping plaza out near the highway exit has not yet resulted in the decay of the main street shopping area, as it has in some towns; but it has displaced the pattern of life, and seems to be an important symbol for the city. The supermarket, discount store, motels and fast food facilities bring revenue in, but they are also an outpost in the mainstream of American culture, a bridge to the outside world and perhaps to the future.

The area surrounding Pine City is densely forested and thinly populated. Where there is open land it is mainly used for grazing beef cattle. At the turn of the century, however, cotton plantations still dominated the local economy, a legacy which remains in the fine ante-bellum houses still to be found in the area, and, some say, in local attitudes and the local political process. Sharp differences and divisions between the lives of black and white, the wealthy and the poor, the powerful and the powerless, might be less marked than in the past, but they remain salient features of the community.



The area is predominantly rural. Pine City children fill only about 25% of the places in the public schools; the majority are bused in from the country. Fifteen years ago the area was dotted with small country schools, and many older people can remember when schools were only open for the four months or so children were not needed to work the land. In those days the system seems to have been more decentralized. Administrators in the office did not always know too much what was happening out in the country. When the country schools were closed, one administrator remembers, it was estimated about 400 children would emerge from the woods to fill places in city schools. When they did close the schools, more than 800 appeared. . . .

Now the school board operates a fleet of fifty-four buses, some children travelling twenty miles to school each morning. Typically these children come from the small farms which scatter the landscape. Despite a high degree of self sufficiency, this is an area where people are mostly poor. About 80% of the children attending Pine City public schools receive free lunches.

Some children in the town attend private schools; there are two all-white schools in Pine City with a combined enrollment of some 500 students (K-12). Others travel out of town to one of the two or three other private schools within easy reach. Pine City also has a small white church school (reputedly with a heavy emphasis on programmed learning), and a long-established black junior college.

It is difficult to find out the proportion of children attending private schools. The estimates people gave me fell mainly in the range of 20-30%. What can be said with some confidence is that the numbers of students leaving public schools for the private academies has declined recently, and there is even some movement of students back into the public schools from the academies. Enrollment figures in the public schools show consistent increases over the past three years despite a declining birth rate and relatively stable overall population figures.

The Desegregation of Pine City Schools

Through 1968 and 1969, Pine City schools were voluntarily desegregated under the state policy of "freedom of choice." One or two white teachers taught in black schools and black teachers began to teach in the white schools. A few black students enrolled at what had previously been all-white schools, but overall the actual changes were small in proportion to the anxiety that was generated. Even these small concessions fired debate and controversy; and many people, black and white, feared what the immediate future would hold. To many outsiders, integration did not seem to have proceeded fast enough, and in 1968 the situation in the town precipitated a federal court hearing.

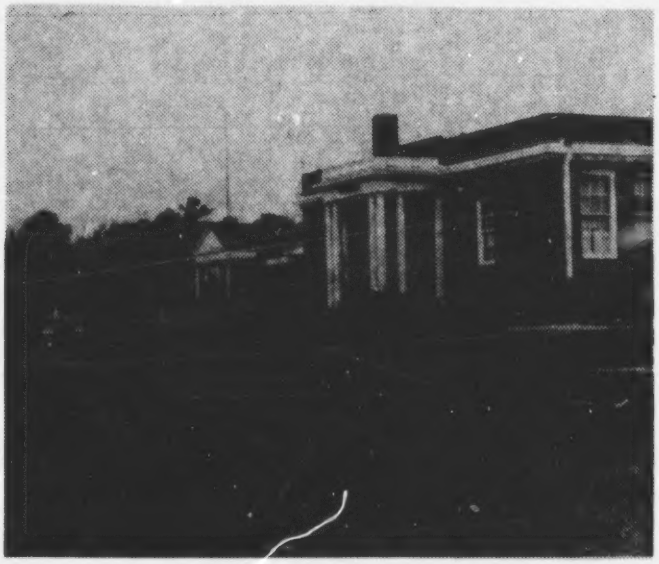
Mr. Collins, the superintendent at the time, had been in office for twelve years and in this time had established himself in a position of some power. Although the school board was strongly against integration, Mr. Collins had foreseen the day when it would become mandatory. In consultation with his staff, he had drawn up contingency plans for desegregating the city schools and awaited events before presenting them to the school board. No one knew what his chances of success were, but his personal position was a strong one and it seemed that he might be able to convince school board members that it was better to implement the plan than to face outside intervention under a court order. In any event, he never got to present his case, for during 1968 he suffered a heart attack and died. One of his former colleagues pointed out that this was not an uncommon fate of school superintendents at the time, faced with both outside pressures and local hostility.

Mr. Allen took over as superintendent; but, being new to the job and lacking Mr. Collins' authority, he was unable to get the plan that Mr. Collins had worked out accepted by the school board. In his position he may well have been unwilling to confront the board on fundamental issues, and may have lacked the detailed knowledge necessary to persuade or out-manoeuver them. Instead, a scheme was evolved--under pressure from a federal court order and with professional advice from one of the new state universities. This plan, implemented in 1970, involved extensive busing of students between the different school sites in Pine City (see Figure 1).

Though this plan was implemented in 1970, it was considered an administrative nightmare. It was expensive to operate. It alienated both students and teachers without resolving community concerns. Students were seen roaming the downtown area during school hours. Rumors of riots and sexual misbehaviour ran rife through the extensive social networks that characterize small towns. The administration seems to have felt that the plan adopted by the school board was impractical and had been inadequately considered. Privately they suspected certain school board members of being near the center of the rumor mill. It was said that school board members even were recruiting students for the private academies.

Present name:	In the 1960s it was:	In 1970:	Since 1971:
Pine City Kindergarten	Black Elementary Grades 1-6	Fourth Grade	Kindergarten
Pine City Primary	White Elementary Grades 1-6	Grades 1-3	Grades 1-3
Pine City Elementary	White High School Grades 9-12	North Campus Grades 10-12	Grades 4-6
Pine City Junior High	White JHS Grades 7-8	Grades 8-9	Grades 7-8
Pine City High School	a. Black Training School b. Black Elementary 1-8 c. Black High School	South Campus plus ROTC and vocational school	Grades 9-12

Figure 1. Changes in the Use of Buildings Under Various Integration Plans



One private school opened in the late sixties (Fort Smith Academy). The founders were mainly lawyers, doctors and business people. One former high school student wryly comments, "They were people who wanted to keep their children away from most other white children just as much as they wanted to keep them away from blacks." Mr. Collins, architect of the original desegregation plan, did little to discourage the founding of this school and another similar school elsewhere in the county, seeing them as a means for containing the kind of dissatisfied parents who might be difficult to contain in a fully desegregated public school system. Like other private schools in the region, Fort Smith Academy quickly filled its rolls. The events of 1970 increased further the demand for private schooling. Next came the founding of Pine City Academy.

Perhaps more than any other single event, the founding of Pine City Academy hurt the pride of the public schools. Not just because yet more students opted out of the public school system, but because this time they tended to be from middle-income, white families, and in particular from parents who were teachers in the public schools. Worse still, the Academy was largely founded on the initiative of teachers, and even two curriculum supervisors, dissatisfied with the way the public schools were being run.

Although it was white families who actually put segregationist pressure on the public school system, many black families were equally beset by anxiety. They, after all, had as much to lose from a faltering education system. But, as one black woman resignedly put it, "No one was listening to us."

It may be hard to imagine what this loss of confidence meant in a small rural town like Pine City. For some it was devastating. The city had always felt great pride in its football team; and immediately prior to desegregation, the community had given it considerable support; "We had a marching band with 250 instrumentalists," one contemporary remembered. But after the events of 1970 there would only be "about half a dozen spectators at the game, and they would have come in the buses with the team, and the band would be ten kids, and maybe three who could play." In a small town in the rural South, it is difficult to imagine a greater catastrophe befalling the community. Nineteen-seventy is still remembered as the "bad year;" the year when the system reached its nadir.

The following year membership of the school board changed; some of the old hardline conservatives were replaced by younger members, and they promptly appointed a new superintendent (Dr. Williams). Faced by the failure of a court-directed desegregation plan, the new administration invited in consultants from another state university.

The consultants agreed that the current plan was ill-conceived and asked if anyone had any alternatives to suggest. It was then that Chris Taylor, the vocational supervisor and a long-standing member of the administration, who had worked with Mr. Collins on the original scheme, suggested that it be resurrected. Essentially that happened. In 1971 a new desegregation plan was implemented, the overall structure of which remains unchanged in 1976.

In 1973, Mr. Tyson, the present superintendent, was appointed. Since then things seem to have run more smoothly than anyone had expected. The last segregated junior high school class has now graduated from high school. The rumors of breakdown in the schools appear to have stopped, or at least to have lost their force. The growth of the private academies has been checked; middle class white students seem to be finding their way back into the public school system.

To the outside visitor it begins to look like a success story. The schools seem to be working smoothly and integration appears to be accepted. Even those who don't like it seem prepared to accept that the process is irreversible and that they will have to learn to live with it. It is still probably true that "given their druthers" 50-70% of blacks and 70-90% of whites would still feel most secure if their children were in "their own schools." But more realize there is no going back and are prepared to live with the system. As one black high school senior put it: "It doesn't matter much to me whether I am being taught in a class with white kids, or whether I'm being taught with black kids, just so long as I'm being taught."

This may seem to the staunch integrationist a poor epitaph for the brave days of Civil Rights, but in the context of the rural South it is giant leap for mankind. And generally it perhaps gives more hope for optimism about the human condition than Neil Armstrong's perpetual footprint.

Context of the Concern - The School System as a Social Laboratory

In the eyes of everyone in Pecan County, integration is the key issue, perhaps particularly in the schools; but anything tied to education pervades the community as a whole. Sometimes it seems as though the schools, and the high school especially, are a laboratory for the community, for it is there that social problems are brought to scrutiny. Some people feel that if integration fails in the schools, few aspects of people's lives would escape the impact of that failure.

One consequence of the mood of successful social experiment in the schools is to make the schools look and feel important. In other parts of the country people may question the relevance of schools as institutions, and ask them to justify themselves. In Pecan County there are people who may question the relevance of some parts of the curriculum, but no one seems to question the schools themselves.

It is not hard to detect this feeling of the schools' running ahead of the community in desegregation, even though the clues are often apparently trivial. They are seen more clearly on social than academic occasions. For instance, a year ago the high school scheduled the first dance to be open to both black and white students. Although the principal had been hesitant about allowing it to take place and ominous rumors ran through the town prior to the event, it proved to be an evening of innocent pleasure. Apparently stimulated by the students' success, the faculty this year organized their own party. It was a friendly, if somewhat formal affair, but it developed into a square dance in the gym, perhaps a third of the guests staying on. Next day the various stories circulated the town. There's no knowing for sure, but it seemed the white girls on the faculty quite enjoyed the scandal of dancing with blacks. And some of the black teachers were apparently amused at the incredulity of soul brothers out of school ("square dancing!").

Another aspect spotlighted by the faculty party: some of the women whose husbands were not in education were being carried along by the process of integration ahead of the "head of the family." This was especially true of those whose children attended white academies. One such teacher admitted to me that she had been surprised to see her husband join a square dance set which included a black couple.

Such detail may seem trivial to an outsider in the face of the real inequities that exist in terms of income, employment, health and housing. Yet despite the reality and permanence of the inequities, a trend in attitude is clearly apparent. The school is running ahead of the community, and it seems on balance to be carrying people with it rather than leaving them behind. (I am reminded of Samuel Stouffer's classic study of desegregation in military combat units during World War II. He found that opposition to desegregation came mostly from people not directly affected by it. He wrote: "The further they are from accomplished fact, the more they disliked it." Pretty much the same seems true of life in Pine City.)

By all accounts those close to the fact have had to learn to live with dramatic changes in the circumstances of their lives. One teacher, now in her thirties, told me how during her childhood on a cotton farm her father had made her shut herself up in the house when the workers went out to work in the fields each morning, and again when they returned. For her the blacks were a close yet strange society which she only saw in glimpses. Yet with desegregation she found herself teaching black students and working with black teachers. She confessed it took some time to learn to listen and to talk to the students; and like several other white teachers, she confessed it was only the tolerance and patience of some of the black teachers that enabled her to adapt to the new circumstances.

The process of adaptation may still be active. The gaps in communication are less marked than they once were, but spaces still exist between words. One teacher articulated the point clearly when she said, "You know I talk to Miss Hall [a black teacher] every day. We work together. But I never really know what she is thinking." The cordiality and hospitality that remain characteristic of social behavior in the rural South retain a degree of ambiguity that allows people to retreat behind custom and habit.

For those pressing more directly for integration, there are still significant barriers. Banking, medicine, pharmacy and the law are still exclusively white, as are most public offices. Yet there is a feeling amongst those in leadership positions in the school system that these are protected more by the expense and exclusivity of higher education than by the local custom.

A mood of optimism, almost of crusade, seems to be what holds the school system together and sets its tempo. Paradoxically, even those teachers who do not share the conviction of the integrationists seem carried along by it, almost despite themselves. I found it quite common for white teachers, who seemed to give no hint of prejudice in school, to return to the conventional racial prejudices and stereotypes out of school, albeit in muted and oblique form. It seemed to me at times that those who were making integration work in school, out of school found themselves puzzled by their own motives. Many of the teachers ran small farms in their spare time, an occupation which provided little financial reward but which, like hunting and fishing, provided an opportunity for solitude and escape. It would be stretching the point to explain this entirely in terms of a search for a return to older values and a previous way of life, but at times there did seem to be an element of this about it.

I confessed to one black girl that I didn't know how to react when teachers, who in school seemed intent on making integration work, out of school expressed prejudice. Should I admire their professionalism or condemn their hypocrisy? She admitted it was often confusing for black students:

> *There are teachers who will be real nice to you in school, but then you'll meet them in town walking along the street, and because they have their wives or their husbands with them, they'll just act like they don't know you.*

The superintendent is seen by most people as being in a key position on the integration issue. He is generally regarded, by opponents and supporters alike, as the person who is making integration work in the schools. His refusal to provide private schooling for his own sons, and his determination to approach integration positively have made a big impact. "Since he came," one teacher said to me on a number of occasions, "the situation has turned 'round and things have just got better and better." However, the superintendent cannot be seen to let the schools run too far ahead of the community; as he repeated to me several times, "Integration is the dominant issue here--I can truthfully say that I never make a decision of any consequence without considering its effect on integration." His own success is bound up with the commitment to make the system work. In steering a way through public concern and established attitudes, he has had to develop a sensitivity for situations not unlike that previously cultivated by blacks. The anecdote that best captures this concerns the mural painted on the primary school under the direction of an artist-in-residence. It just happened, she explained, the the black children wanted to paint people, while the white children wanted to paint houses, buses, trees and flowers. The result was a colorful landscape, peopled by black figures. The mural is in a prominent position readily visible to visitors to the schools and the school board office, and as it neared completion the superintendent walked across from his office to take a look. "Very colorful," was his pointed comment. Shortly thereafter there were some white faces too, roughly in the proportion they are in the schools (but still with brown bodies). His sensitivity may not be infallible, but it is ever active.

THE CURRICULUM AND THE SCHOOLS

For the past few years the dominant concern has been with the relationship between the school and the community, rather than with more strictly curriculum issues. It is as though the curriculum reforms of the sixties had passed the school by; or to put it more accurately, only now is the school ready to contemplate the kinds of curriculum reform advocated by curriculum developers over the last fifteen years.

There have been curriculum experiments. The junior high school for a while ran a course in aerospace studies, which is now limited to part of a more general course. At least two of the science teachers have had summer training in the "new" curricula (BSCS), but on their return have found it impossible to contemplate implementing it with the limited resources available.

Given the current situation in the schools, it seems unlikely that either of the high school principals would push for greatly increasing the rate of curriculum renewal. Mr. Carter, the junior high school principal, has as his main concern the efficient running of the school and the overall behavior and attitudes of the students. He worries about the high-risk pregnancy cases much more than about increasing the rate of curriculum change. His concern is for the students rather than for the curriculum. Mr. Barnes, the high school principal, too seems increasingly involved with administration: "This job is 90% paperwork. It hasn't always been like that, but it seems now that everything has to be filled in in duplicate and triplicate." Glancing over the pile of mail that had arrived on his desk that morning, he added, "I've just received this [holding up a several page questionnaire], from the State Ethics Committee. Everyone earning over $15,000 a year who holds a position where they have to deal with money and contracts has to fill in one of these detailing their income from salaries, interest, mortgages, stocks and shares, and so on." Mr. Barnes is a mild-mannered, quiet-spoken man, not usually given to taking a radical stance over such things, but he gave the document the nearest he probably ever gets to a severe look and added, half joking at his position: "All things they've got no right to know. I'll think about it, and I may decide not to fill it in!"

On another occasion an interview I had arranged with Mr. Carter was interrputed for fully fifteen minutes while he tried to extricate himself from a telephone conversation with a persistent ball-point pen salesman. "How's the hunting season down there?" the salesman started out, just as though itwere a social call. . . .

The building principals are concerned to hold on and consolidate the position they have won on desegregation. The superintendent, though, takes a long-term view and a more direct interest in curriculum issues. It is, for example, through his urging that the county has an artist-in-residence working in the school system, and (for the first time) a full-time art teacher in the high school. He would like to see art and music extended, and after that perhaps the social sciences. . . .

It would be a mistake to over-emphasize the difference in viewpoint between the superintendent and the principals, for the differences seem rational and objective, not personal. I first realised some of the implications of these different ways of looking at the world in discussing the evaluation of teachers, a topic Mr. Tyson, the superintendent, frequently thinks about. Mr. Barnes, the high school principal, told me:

> *Mr. Tyson would like to see us in the classrooms observing the teachers on a regular basis. But I feel I should be close to the office where people can find me if they need help or advice. We've built up a good atmosphere in the school, and I think teachers and students do feel free to come to the office if they have problems, or if they just want to talk. I always try to be available when classes change and during lunch time and break, which means I have to get the administrative things like phone calls done, and seeing visitors and parents during lesson time.*

The students do not all share Mr. Barnes' perception of the accessibility or impartiality of the office, though between the principal and the assistant principal most students feel they can rely on a sympathetic hearing. Mr. Barnes has other ways of keeping his ear to the ground. When a previous science teacher upset students by teaching "too far above their heads," news soon reached him, not only from the counselors, but through the informal social networks that so often add complexity and interest to life in a small community.

Mr. Tyson, the superintendent, feels Mr. Barnes takes the paperwork too seriously. "The principal's job is the curriculum. He should know what is going on in every classroom." Adding, only partly tongue-in-cheek, "everything else can be done at the weekend."

The difference in viewpoint between the superintendent and the principal is an interesting one. The principal sees his job as primarily concerned with immediate events. He feels he has to be at the centre of things in case there is any trouble. He sees himself as a conciliator, and as responsible for containing delicate situations. This perception of his role is certainly in part a legacy from the recent past when everyone feared what dominoes might fall every time a word was said in anger, or a black boy was seen chatting with a white girl.

In the interest of "security," student movement around the school has been reduced and extra-curricular activities have been cut. Clubs only meet briefly once a month, field trips are quite rare and student social activities are planned with great care.

Such attention to administrative detail might seem more like over-reaction than prudence, but the principal had to respond as much to public concern as to the likelihood of real trouble.

Mr. Barnes told me:

> *You've probably noticed that we have two bells between classes. First the girls change class, then the boys. The reason is that these buildings were originally designed for elementary school children, and they just get too congested if all the students move together. We've had student committees try to think of better ways of doing it, but this seems to be the best. But in the town the rumor went round that things were so bad here that we dare not let boys and girls out into the corridor at the same time!*

Mr. Barnes has had reason to develop a fine sensitivity to the potentials of rumor and a strong sense of caution. Some of the students feel he has been overly cautious at times, but the fact that the situation is as stable as it is is certainly due to some extent to his sense of caution, backed up by the assistant principal's experience and authority in the black community.

Principal and assistant principal complement each other in many ways, and if there is a question mark over the school it may well centre around what happens when the assistant principal retires in two years' time.

In contrast to the building principals, the superintendent, Mr. Tyson, prefers to take a longer term view, to adopt a more challenging stance, and perhaps to take risks. He is a strategist rather than a tactician (maybe his background as a football coach is significant). To the cautious he may sometimes seem a dangerous idealist, but his survival in a difficult situation is mostly due to his persuasiveness and his ability to command loyalty from his staff. Somebody commented to me, "He's a great man to work for because he gives you the feeling he trusts you. He's not breathing down your neck all the time." It is an approach to management that has won him respect even from those who do not wholeheartedly agree with his ideas; as someone else told me, "I'm awful glad I work for him and not against him."

In the eyes of his admirers, Mr. Tyson's great strength is that he sees things in terms of people rather than systems or organisations or models or plans. His appointment strategy is to hire people who "look good, sound interesting when they talk, who seem to be good people. If I like the look of them I hire them first and find jobs for them afterwards. You can always find jobs, but finding good people is hard." He likes to quote the football coach: "This is a people business." He does have interesting people, often with unusual career histories. An ex-U.S. Marine who teaches in kindergarten, for example, and a one-time high school home economics teacher working in the first grade Title I program. Choosing interesting people is an important element in his strategy for curriculum change. He likes to give freedom to people who have a sense of vision. It is a style with obvious attractions, but it has its risks. Mr. Tyson puts his judgment of people to the test; he commits himself to the success of those he has sponsored into the sytem, and so becomes vulnerable to their failures . If he intervenes, he knows he risks alienating large sections of the faculty. As yet, no major incidents of this kind have occurred, and if they did he would no doubt survive. Nevertheless, the sense of risk is always present. Those thus sponsored into the system find themselves with remarkable opportunities, but sometimes with a sense of isolation from their colleagues. From the beginning they are marked out as unusual or different and can find themselves in a position of some isolation. When this happens to teachers in a city they can often find alternative kinds of support, perhaps in a nearby university or in some quite different pursuit. In Pine City, however, there is very little else to turn to, especially for the single teacher used to city life. It may mean travelling out of town for the weekend just to find someone neutral and supportive to talk to.

It remains to be seen whether Mr. Tyson's concern with curriculum issues will leave an impact on Pine City. Despite his success in other directions, it is a vision that seems to run counter to all visible trends. Perhaps he will not remain long enough to find out, for some of his colleagues predict he is destined for promotion to a bigger district.

THE TEACHING OF SCIENCE

First Impressions

A glance at the daily schedules and the faculty list shows that science plays an important part in the curriculum of the high schools. Compared to schools in other places the emphasis is not unusual, certainly not startling, and the content of the courses seems orthodox. For the casual visitor to the school, examining the actual curriculum, science plays a lesser role than it does on paper. In junior and senior high school alike, there is only one room equipped as a laboratory. In one school it is only distinguished by a demonstration bench; in the other, by table space for perhaps twelve students to work. There is nothing like purpose-built laboratories or computer terminals. In the time I was in the high school I did not see microscopes, circuit boards or bunsen burners in use (though no doubt some of these things could be found in cupboards).

The one science teaching resource that seems in abundance is the textbook. The books look new and expensive, in marked contrast to the laboratory equipment and the classroom furniture. The libraries have interesting selections of science, and science-related books, and schools receive regular copies of the magazine Current Science.

To the curriculum analyst visiting the schools, the science courses would not appear exceptional, but they are conscientiously taught by popular teachers. Despite the reputation they have for being difficult courses, science and math attract growing numbers of students. The observer would probably notice, though, that for the most part science is taught in classrooms by people who see their role as teachers who happen to teach science, rather than as active members of the scientific community who happen to teach.

The Teachers

The science teachers tend to be in mid-career, but include both young and highly experienced teachers. They seem well-qualified, especially in the life sciences.

Like teachers in other subjects, for the most part the science teachers are natives of Pecan County, or the neighboring counties. Many come from farming backgrounds and still live in homes their parents owned, or on the family farm. They would joke that commuting into Pine City was their one contact with the "big city and the bright lights." "The place I come from," one told me, "people drive into town on a Saturday night just to watch the traffic light change." Living in a rural area isn't something they see as a disadvantage. They have chosen this way of life. One biology teacher summed up his own feelings and doubtless those of several others when he told me, "I've only been out of the county once, when I went to school, and that was enough." (The university he attended was only a two and a half hour drive from home.)

Many teachers live in Pine City itself and a few commute from the state capital, less than an hour's drive on the interstate. My impression was that black teachers tended to be more urban-oriented than white teachers. However, none of the high school science teachers was a city dweller: most were country people.

Another characteristic of the teaching body as a whole is the extensive marital and kinship networks that create the basis of a rich informal communication system. The wives of the superintendent, the high school principal and the junior high school principal all teach in the senior high school, and there are numerous wife-husband teacher pairs, and even two brothers teaching in the same department. More than in other subjects, however, science seems relatively unentangled by such relationships.

A Key Issue: How to Motivate the Students

Motivation and Discipline

Discipline is not a major issue for teachers in the high school. The school shows none of the marks of a faculty under siege from the students. The teachers come into the teachers' lounge at break relaxed and talkative. The corridors and classrooms seem free of the usual signs of vandalism. Between classes students move in groups rather than as masses. The police rarely visit the school, and then only on invitation.

If you ask the teachers about discipline, what they tell you about is the problem of getting students interested in the subject, rather than how to handle confrontation. Those incidents that do arise seem mainly to involve students' talking in class, or at worst, talking back to teachers. The worst discipline incident that occurred while I was at the school concerned a boy who let off a firecracker outside school--an action that cost him five days' suspension from school.

As you walk down the corridors during lessons you don't hear teachers shouting or students clamoring for attention. It is not a common occurrence for students to be paddled. The general atmosphere is one of an efficient, perhaps unquestioning institution, where most people (administrators, faculty and students) seem mostly concerned with getting on with their work.

Most teachers agree that the key problem is motivation. "In every class there are one or two, perhaps sometimes it's more, who just sit there, and whatever you do, however hard you try, it's just really difficult to reach them."

One of the guidance counselors sees the problem as being a general one:

> *Motivation really is the big problem here. I don't understand why it is, but looking at it rationally, students in the Northeast of the United States consistently score higher on tests of academic motivation than students in the South. Yet I am sure our students are just as able.*

Motivation is an issue at the junior high school, too, though here it is more often expressed as a discipline or behavior problem. Where the assistant principal of the senior high school despairs of students' (black and white) failing to capitalise on their abilities

and opting for courses below their capabilities, the principal of the junior high school worries more about disorder and changing moral values.

Local perception has it that a particularly difficult year-group is presently going through the system. The teachers say that the current seventh grade has a generally low standard of attainment, lacks a core of highly able students, has more than its share of remedial cases, and is generally immature. The principal worries about a number of the girls who seem to him to be high risk pregnancy cases. He sees this really as a problem beyond the school's control, but worries anyway. In Pine City parents and neighbors often make such things seem the school's responsibility. It's not that teenage pregnancies are any more frequent than they ever were, the principal explains, but he seems at a loss to understand current attitudes toward such things, particularly the lack of guilt, concern, or even foresight that students seem to show.

Against this background I want to look in some detail at the way science is taught. A good place to begin is with general science classes at the high school.

Two General Science Classes

Mrs. Griffin is one of three science teachers in the high school. She has been there six years, having taught for one year in the junior high school. Mrs. Griffin's day is spent teaching general science and practical science.

The first thing you notice about general science is that the classes are larger; twenty-six students are in Mrs. Griffin's class, but it seems more because the room is small and even the desks seem small. (A good few of the students are bigger than me and I have trouble getting into the seat.) At one time classes were even bigger. A math teacher told me: "The administration has gone all out to reduce class size, and they've done a good job. . . ."

There's space for little else in the room besides the students and little to distinguish it as a science room. Up in front of the room there's a small mobile demonstration bench which looks new and unused (Mrs. Griffin explained that the room has no gas and no water). On one wall there is a commercial poster about metric measures, but few clues that this is science. The blackboard still retains the notes from the previous practical science class, about tides and eclipses, and the rotation of the moon around the earth and the earth around the sun.

The grade nine class has just started a new chapter in the textbook, on the atmosphere. Mrs. Griffin explains that they have been writing assignments on this work and that in this lesson she wants to see what they have done. She has them read at length from their work while she goes to a back corner of the room and listens.[1] Between each student's reading she asks questions of the class and elaborates the answers.

The assignments appear to have been done thoroughly. Most of the students are able to answer the questions that Mrs. Griffin poses. Sometimes it takes them a little time and some guessing to work out the answer she wants, but in the end they get there:

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[1]When I asked Mrs. Griffin if this was usual, she said: "In the back of the room I feel close to all the students; at my desk only a few seem to get my attention."

"What happens in the air?" Mrs. Griffin asks.

"Precipitation."

"We're not talking about rain."

"Rain."

"We're not talking about rain."

"Air."

"We're not talking about air."

"Weather."

"Right."

Inevitably, given the crowded class and the long periods when most students have nothing to do but listen to another student reading, the attention of some begins to wander. Two boys in front of me flick pencils and a small group of girls periodically break into giggles (at me, I fear). Overall, though, what is surprising is not that a few seem distracted, but that most seem quietly intent on the lesson, following the reader, glancing at the text and taking notes.

Part way through, Mrs. Griffin tries to breathe some life into what is hardly a riveting subject by extending the section on flight, especially referring to Charles Lindbergh:

Just before he died he gave a speech in Birmingham . . . Do you know why he nearly didn't win the prize, even though he was the first to cross the Atlantic? That's right, he left before he should have done in order to be sure of being first. He wasn't as interested in the money for the prize as he was in the fame he got for being first. After all, we all remember Charles Lindbergh, but hardly anyone knows the names of those who were also in the race but lost.

Out of the class Mrs. Griffin has an easy, friendly relationship with students, marked by a gentle sense of humour. It is hard for her to capitalise on this natural informality in a crowded class, but there are moments when the out-of-class Mrs. Griffin surfaces:

People sometimes ask, with him being alone all that time flying the airplane, what did he do when he wanted to go the bathroom. It's a good question . . .

She continues to work at making the text as interesting as she can by emphasizing the human aspects:

What was the tragedy in his family? It was quite dramatic. That's right, his son was kidnapped. How long before they found him alive? No. They never did find him alive, and the kidnappers were never caught.

Comments. Faced with a large class and a somewhat pedestrian text, Mrs. Griffin adopts a teaching style that optimises those elements that raise interest.

First, she goes out of her way to avoid technical vocabulary and always succeeds in presenting the subject in straight-forward English while retaining some regard for precision:

There are two kinds of barometers. The aneroid or liquidless barometer and the mercury barometer. What is the difference between them? What's the purpose of any barometer? Does it measure temperature, or pressure, or what? Pressure difference. That's right. The author mentions that one has advantages. Which? The "spring?" Which one is that? The aneroid, right. The aneroid has another advantage over the mercury barometer. Whichever way you turn it you can read it. In junior high school they have a barometer on the wall right outside Mr. Turner's room. Do you remember? The other thing is it doesn't make a mess if it breaks. If you ever see mercury you'll know you don't scoop it up. Any question on that?

Second, as we have seen, she holds the interest of the class by extending the human aspects of the subject, frequently making references to current events or general interest. Perhaps this was a natural emphasis for Mrs. Griffin to make. It does not mean, however, that she devalued the more purely scientific aspects of the subject. Commenting on the omission from one student's assignment she said: "Another thing we should know is that atmospheric pressure is 14 7/10 pounds per square inch. 14.7 lbs/sq in." She turns to the boy who omitted this from his report:

Where's this about supporting a column of mercury 760mm high? Where's that in your report? Scientists agree on this particular point. Why didn't you tell us about this?

Perhaps one of the hardest ideas for the student to grasp is the notion that air has weight. It is particularly difficult in the absence of experiments or demonstrations, neither of which is practical in the classroom. Mrs. Griffin tries hard, within the limits of the situation, to provide convincing evidence, but in the end has to resort to verbal explanation:

There's one thing you can do, in here right now, to show that air has weight. [Ruth is dropping a sheet of paper and watching it float to the floor.] Ruth has one idea. You can also blow on the back of your hand. Try it and see. Feel the air? There's also an experiment that you can do with a balloon. It weighs more with the air than it does with the air out. . . .

It seemed to me that simply describing such an experiment was unlikely to communicate to the students. Maybe the students understood better than I thought. The final question was the telling one: "When you go to the service station are you actually putting in thirty pounds of air in your tire?" Most of the students had the answer immediately. "No, that's the pressure."

Miss Green teaches chemistry as well as general science. She also teaches physics, but this year there were too few students to constitute a class. This is her first regular teaching job and she has been at the school two years. She describes the problem of teaching general science, and outlines her strategy as follows:

In general science classes we have general to basic students. I think the only way to reach them is to teach them something they can relate to, i.e., no abstractions. I have left the book almost entirely in order to teach things they can relate to and enjoy, and I find I get more response and motivation in this way.

She goes on to explain:

These students come from [mostly low income] rural areas and their parents do not encourage or push them. Many will be high school drop-outs. I try to teach them things that will be useful in everyday living even if they do drop out. If they do stay in school, they'll get more factual information as they progress.

Miss Green clearly has a good relationship with her students. She spends time talking to them out of class and in many ways feels close to them. She shares their background and still lives, on her own, in an isolated part of the country. ("Coming to Pine City each day is coming to the hustle and bustle of the metropolis for me," she joked.) It is not so many years since she was a high school student in one of the county's other schools. Summing up the situation as she sees it, she wrote for me: "I feel that the overall problem is lack of motivation at home, but then this is what we have to cope with."

Thirty students arrive for the general science class, but again there seem more because the room is quite small (the buildings were originally designed for elementary school students). This class, too, is studying the atmosphere, and Miss Green has had them collecting barometric pressures from radio weather broadcasts. They are trying to discover how to predict rain. So far it looks like you get rain when the pressure rises, but the class decides it's hard to tell with just two days and only five sets of readings recorded on the blackboard.

Up in front of the class is a mobile lab bench (which also doesn't work). Miss Green has managed to find a vacuum pump so that she can demonstrate some experiments on air pressure, but as she explains to the class, they tried it yesterday in another class and discovered that one of the valves was faulty, making it difficult to get the experiments to work. In addition, one of the most dramatic of all the demonstrations--the silent alarm clock ringing in a vacuum--had to be aborted because the clock was too big to fit inside the bell jar.

Miss Green's general science class is one where the students seem to ask a lot of questions. Whatever they ask, she always tries to answer, even if they seem off the point. The first question of this lesson is a good example. A boy at the back asks: "Someone in sixth period told me to ask you if you would bend your arms round backwards and clap your hands." Miss Green counters skillfully, accepting the question but declining to demonstrate:

"We were discussing being 'double jointed.' You know what that means? Being able to move in funny positions, that's right. Well it happens I can do some of those things--it's not really the bones that are jointed any differently, it's how flexible your ligaments are."

"Can sound go through a vacuum?" someone asks.

"Well if this pump was working I could do the experiment with the alarm clock and show you, but unfortunately I can't."

The question seems to be the key form of communication in this class. Not only do students ask questions of the teacher, but she rarely talks for three or four sentences without asking questions of them:

"Tell us how an aneroid barometer works," she asks of a boy who uses the term.

"It's a vacuum between two plates with a spring." Miss Green repeats and elaborates the answer to the class. "We have another kind of barometer; what's it called?"

Someone else answers, "Column of mercury."

"What are its disadvantages?"

"Poisonous."

"Expensive."

"What is the height of mercury in the tube?" Miss Green asks.

"Thirty inches."

The tone and style of the lesson is conversational rather than rhetorical. Teacher and students do not constantly glance at the open pages of the textbook. The questions students raise seem to be from thinking about the problem rather than from the multiple-choice test.

Someone asks: "Where does the air in the tube of mercury go?"

Miss Green explains: "It's a vacuum," and she describes how the barometer is made. "I'll be doing this tomorrow and showing you, so you'll see. There's no air in the tube, it's a vacuum."

She continues: "What did we say about mercury?"

"It's heavier than water."

"How much heavier?"

"13.6 times."

Miss Green holds up a small plastic bottle in one hand. "Does this look heavy?"

She passes it to one student after another. No one believes how heavy it is until s/he feels it. Once several people have felt it, she lets them pass it around along with a smaller glass bottle. She warns: "Be careful with it. It's very expensive. Two years ago it cost $110 for five pounds, and it'll be more now."

"How much is there there?" someone asks.

"Well, the small bottle is a fourth of a pound; you'll have to guess how much the big one is."

"You must be careful not to drop it because it is highly poisonous and if you drop it we'll lose it. And if you have any gold jewelry on it'll go black, like my ring here. And you can't just polish it off. It forms an amalgam and the jeweler can only remove it by agitating it very fast in a special solution."

"You can't see it," someone complains, looking at the bottle.

"I'll put some out on my hand. Sit down and I'll bring it around." She waits for quiet before continuing.

"Is it wet?" one girl asks.

"No, it's liquid metal. See, my hand is quite dry."

"Isn't it poisonous?"

"Well, it's not just absorbed straight into my skin in such a short time, but you've heard about mercury poisoning of fish in the news?" (Several have.)

"Would it freeze?" a boy asks.

"Only at minus 38° or something."

"How do you pick it up?"

"It's very difficult; as you try to pick it up, it breaks into smaller and smaller pieces."

As she returns it to the jar, Miss Green issues an advance warning. "Tomorrow we're going to have an open vessel of mercury here. Don't be tempted to put your finger in it."

By this time Miss Green has shown the mercury around the class and everyone has had a chance to feel the weight of the bottles. For the last twenty minutes or so that remain she returns to more formal class discussion and more directly to the text. Now she takes the lead in asking the questions:

What are the reasons for wanting daily weather reports? Can we get accurate extended forecasts? Can you control weather? What is climate? What do we call the scientist who studies weather?

The class answers promptly and almost all seem interested and attentive, though this class, too, has two boys flicking their pencils one against the other to see which one breaks first. Miss Green quietly removes the pencils and they subsequently pay attention.

Most of the questions are review questions which require single, short answers; but one question, "What makes up weather?" produces a list of items which Miss Green writes up on the board.

Wind. Temperature. Rain. Sleet. Air Pressure. Moisture [let's put that with rain]. Humidity [that can go with rain, too].

Having got the list, they work through each item one at a time, beginning with wind. The students answer spontaneously, though most have their books open and some are making notes as they go along. They respond quickly and hurry the pace of the lesson along.

"What does temperature measure?"

"How hot or cold it is."

"Where does the heat come from?"

"Sun."

"What affects how hot or cold it is?"

"The angle it strikes the earth."

"What keeps us from getting too much heat?"

"Wind."

"Clouds."

"Atmosphere."

"Right, by screening rays."

"Ozone."

"Ozone, right. That blocks out harmful rays."

"We've had this recent controversy. [pause] Temperature has more effect on weather than almost any other factor. How do we measure temperature?"

"Thermometer."

"By thermometer. What kinds of thermometers are there?"

"Alcohol and mercury."

"Right. Let's go on to moisture."

"Is that how much rain you get?"

"Right. Rain and sleet and fog and snow [writing them on the board]. Could we also include humidity? The amount of moisture in the air? Why is it you find it hard to breathe in the summer when it gets very hot and humid before rain? Because the air is so heavy with moisture. But immediately after it's rained, you can suddenly breathe easier."

(She moves on to air pressure.) "What do we measure air pressure with?"

"Anemometer," one boy answers.

"Barometer," several students immediately correct him.

"What's an anemometer?" Miss Green asks.

"It measures wind speed."

Some of the class don't understand. "Let's go back," the teacher says. "Have you ever seen an anemometer?" picking up the two confiscated pencils and holding them in a cross. "It's like this, with cups on each piece which the wind blows around, and the wind speed is measured by how many times it goes around."

Next they consider the weather vane and Miss Green draws one on the board, pointing east. "Is the wind coming from the east or west?" Only three students guess right. "We name the wind from the direction it comes from--we say, 'ooh, that north wind feels cold.'"

"How do they name hurricanes?" someone asks. Miss Green explains how they are named in sequence. "I don't know why they are named after women. Maybe because they are more temperamental! Perhaps with equal rights they'll have to start naming them after men."

The bell goes to mark the end of the lesson and the class disperses to an assembly to salute American Education Week. Miss Green apologizes to me because she felt the class had been unusually noisy. It hadn't seemed noisy to me, but each school has its own norms about such things. What is interesting is the general point that in overcoming the problem of lack of interest and motivation amongst students, the teacher inevitably runs into the problem of noise. They are like opposite faces of the coin. A highly motivated class creates work for the teacher and carries a potential for seeming unruly. Within the climate of this school, Miss Green seems to be working hard to balance the coin on edge.

Next day I arrive at the same class, hoping to see the barometer being made. Miss Green explains that the assembly took up her planning period yesterday and she hasn't been able to prepare the sealed glass tube she needs to construct the barometer.

On Friday there are twenty-six students in class. Miss Green begins by collecting the day's barometric pressure readings from the class. At 7:00 a.m. this morning it was 30.2 inches and falling; outside it is pouring rain.

Miss Green holds up a sealed tube and says, "I want you to gather round the table and watch. I'll want one or two to help and the rest of you to watch." The class is extremely quiet. Miss Green takes a beaker from the cupboard, and finding it dirty, sends someone to Mr. Rodgers to exchange it for a clean one. When everything is ready she says, "Eddy and Patricia can help because they always answer my questions for me."

The class gathers round one of the front tables. Eddy holds the mercury bottle and Patricia, the glass tube. Miss Green runs the mercury into the open end of the upright tube from a syringe. Finding she can't reach, she gets a chair and stands on it. It takes the best part of the half hour to fill the tube, get the bubbles out and invert it in mercury. Throughout this time the class is not only quiet but silent. (Afterwards Miss Green explains to me that she had had a word to them about the previous lesson. As a result, we see the other side of the coin--if the class is kept down too much, then you lose the genuine questions and the curiosity that, as a teacher, you need if you are to get beyond instruction to any form of inquiry.)

The last twenty minutes of the lesson Miss Green reviews the work on air pressure for Monday's six-week test. The class begins to recover some of its energy and momentum and to ask some interesting questions. Patricia asks, if you put more mercury in the beaker at the bottom of the barometer, wouldn't this force the column of mercury further up the tube?

One boy is puzzled by the apparent similarity between the barometer and thermometer. For a moment I thought he was going to ask if you could use the barometer to measure temperature, but he doesn't quite make the connection. Asking about mercury and alcohol thermometers, one boy asks if you can color mercury. Miss Green confesses she doesn't know (nor do I).

Looking at the lessons described here from a distant, primarily non-educational viewpoint, I think any observer cannot fail to be impressed by the fact that the resources tied up in teaching here are almost entirely human resources. The buildings and furnishings are minimal. People are crowded into spaces and lesson follows lesson with little time to spare for teacher or for students. In purely economic terms, the proportion of the total input that goes into materials is minute (even with mercury at $20 a pound!). Most of the equipment and resources look run-down to a degree that would be unacceptable in any commercial or professional enterprise, not through mis-treatment but through sheer use. The exception is the textbook, which stands out, shiny and new (I'm told these are bought from state rather than local funds).

I find myself amazed at the continuing energy and good humor of all the teachers, and wondering how long Miss Green, in particular (as a recent graduate), will go on trying to get some kind of experimental approach to the subject established against all the odds.

It is fashionable in some circles to accuse the teachers of failing to implement the curriculum innovations that have been made in science over the last twenty years. It is often implied that the teachers do not want to change the way they teach and will do all they can to avoid doing so. Without wishing to imply that the teachers portrayed here should change their teaching, I think it is quite obvious that most innovative programs are beyond their reach simply in terms of equipment, space and resources. They work in a stable organizational situation, have good relationships with the students and have access to a remarkable natural environment. What they lack is even the most basic laboratory equipment and facilities; not the luxuries in terms of expensive equipment that is used once a year, but the microscopes, chemicals, glassware, space, even gas and water, without which it is really not feasible to contemplate a basic experimental science curriculum.

In writing this comment I had in mind a vision of an alternative pedagogy shared, I think, by many science educators. In fact it's more than a vision because you can see it in action not more than a few minutes walk from the classrooms in the Trade School, and perhaps particularly in the auto shop. Here the teaching is based on individual projects and is problem-centered, in the sense that cars come in for maintenance or repair and students work on them individually or in pairs. The teacher is available as organiser, consultant and supervisor rather than as curriculum ringmaster. It seems significant that

this was the only place in the school I heard students call the teacher by his first name. Their respect for him was for his expertise rather than his position. The students in the auto shop work as essentially apprentices rather than as clerks and collectors of information.

It is possible for science, too, to be taught along these lines (perhaps the school system needs a scientist-in-residence like they now have an artist-in-residence). I don't know if Miss Green shares this vision, but she did feel I had overduly emphasized the material aspect of the situation, and perhaps undervalued the personal and professional qualities demanded. After reading this section she wrote:

> *As for equipment and resources, we are lacking; but if we really need something we can usually come up with it. It's true that if we had these things readily available, it would be much easier. As it is, we can sometimes let students work to get the things we need, which in turn motivates the students.*

Miss Green sees the key question, not in the provision of resources, but at a more directly educational level. She writes:

> *I'm striving to motivate my students to find something that they will be interested in. When I see them full of questions--really interested--then I find ways or sources from some place. To me the most stimulating experience is feedback from the students.*

I had to admit I've seen schools lavishly equipped for science where no real science was going on. On the other hand, I can't escape from the fact that it takes an enormous amount of energy for a teacher in Miss Green's situation to do anything even slightly out of the ordinary. That making those sorts of changes gets harder as time goes on, rather than easier, and that in the interest of survival most teachers soon drop to an energy level below that required to put a philosophy like Miss Green's into practice. In the recent past the turnover rate of young teachers in the profession has sustained the impetus for change in at least some schools. Given the current state of recruitment to teaching, that is a situation that must be changing.

The second impression that the science teaching in particular made on me as an observer, is the lack of outside support for the teacher in terms of classroom teaching. I started out this account with the question, "What motivates the students?" I don't think we can begin to answer that question until we understand more about what motivates the teachers.

The system is not big enough to support a science supervisor, and in a rural area it is a long way to the colleges and universities that might provide some leadership in particular curriculum areas. There are, of course, a lot of advantages to set against this; nevertheless, it seems to me that a major problem for the science teachers is that they have few easily accessible people with whom they can identify as biologists, chemists, physicists, scientists. Primarily they see themselves as teachers; and my guess is that the longer they teach here, the more this will be true.

Of course this, too, has undoubted advantages, but if the concern of the NSF is with the improvement of science teaching, I would think one line of development might be to enhance the scientific identity of the science teachers. At the present it seems something that science teachers can all too easily lose once they leave college.

When I raised the question of the science teachers' identity qua scientist in a small town community with one of the guidance counselors, she commented that a critical factor was that the town's doctors and pharmacists all aligned themselves with the private schools, and this seemed to cut the local scientists off from public school life. This echoes the

superintendent's comment that the desegregation issue impinges on almost all other issues of any importance.

Why Does Patricia Like Science?

Observing Mrs. Griffin's and Miss Green's classes led me to feel that I should try to distinguish between motivation and interest. Motivation seemed to be something the teacher could create, or at least inspire, by skillful teaching. Interest seemed a more permanent and elusive factor, coming from the student rather than the teacher.

Patricia is the quiet girl in Miss Green's ninth-grade general science class who held the glass tube during the making of the barometer. It was also Patricia's question to Miss Green that if you put more mercury in the beaker at the bottom of the barometer, then wouldn't the weight of mercury press the column further up the tube?

The records show she has done well in general science, having virtually straight A's this semester. She'd started the year in biology but had lost some classes while out of school following an accident. On her return she had worried about the work she had missed (though she'd been a good student in biology, getting A's there, too). Eventually her mother came up to the school and it had been agreed that Patricia should transfer to general science. She didn't regret the decision; biology had seemed to be mostly learning words and some of them were long and difficult to remember. "Several of my friends who are still in biology wish now they'd done what I'd done. General science is more interesting and you get to do different things. The other thing is there is less homework to do."

When did she first get interested in science? She says she's been interested in science as long as she can remember, certainly since third grade; but what really spurred her on was being in Mrs. Clark's class in seventh grade. Mrs. Clark had clearly made a big impact on her. Patricia described her as "fussy, but she made science interesting and you got to learn a lot." Under Mrs. Clark's influence she'd joined the science club in junior high school and had won a prize for a project on cactus. Eighth grade had not been quite so interesting; there had been no experiments and mostly it was about planets and atoms. She liked experiments and found it was much easier to remember things when you had seen them instead of just reading about them.

I asked if she read science out of school, but, except for sometimes looking things up in the encyclopedia, she didn't, mainly because "homework takes up all your time. There isn't much time for anything else." She wasn't interested in science fiction or science magazines. She enjoyed the science she did at school and had always been quite good at it, but she really didn't know if she'd take it any further.

Words and Things

After talking to Patricia I talked to other students who confirmed that Mrs. Clark had been an early influence on their liking for science. I found Mrs. Clark in the junior high school and asked her if I could observe in her seventh-grade general science class.

I sat near the back of the class and was given a copy of the text. The introduction caught my eye. Under the title, "Using your book scientifically," I read the following:

Scientific information is the sum of present knowledge about the world and you, which has been brought together and organised. You, the student, absorb this knowledge by reading, remembering, and recording each fact. This is a process which must take place before you can relate or connect one idea or fact with the next.

There will be many new words in your study of science. Each scientific term has a new meaning. Be sure that you understand what each new word means. Try to make these scientific terms part of your vocabulary. To communicate with others in science you must know the words if you are to express your ideas accurately. To help you in this way, the important words in the text have been italicised, pronounced and explained. . . .

After you understand the meanings of the words, work at learning the meaning of each sentence, then each paragraph. Then, relate what is in each paragraph to the topic you are studying. . . .

Blanc et al Modern Science.
Holt, Rinehart & Winston
rev. edition 1972
(italics in original)

Mrs. Clark is one of the most experienced teachers in the city and, as one of the first black teachers to work in the previously all-white junior high school during the voluntary desegregation of the late sixties, she has an identity in the system outside the subjects she teaches.

The class I observed had spent the previous lesson in study hall working on a test that Mrs. Clark had duplicated from the Teachers' Handbook (accompanying the textbook). The text chapter is called "The Diversity of Life," and the section covered by the test is mainly about plants, fungi, algae and bacteria. There are twenty-seven students in the class.

"How many have completed the test?" Mrs. Clark asks the class. Most raise their hands. "How many have mastered it so that they can talk about it?" A smaller number raise their hands. "It isn't enough just to be able to give the answers to the questions. You've got to know the words and be able to use them in sentences. How are you going to be scientific if you can't do that?"

Mrs. Clark stands at the front of the class and asks Shirley to tell the class what she has on her paper. Shirley is a tall white girl sitting in the middle of the class; she stands and reads the questions and her answers. After the first question she pauses, but Mrs. Clark asks her to go on until she reaches the bottom of the first page. Some of the words are long and difficult to pronounce. Shirley stumbles over "saprophyte" and ends up spelling out the letters rather than saying the word. "I have the answers," she explains to Mrs. Clark, "I just can't pronounce them."

Next, Mrs. Clark asks a black boy sitting up near the front to "stand up and expostulate." He has real difficulties and is unable to get past the first question. "I don't mean to pick on you," Mrs. Clark explains to him, "but I think we have what we want."

A girl stands and reads her answers to the first page of questions, perhaps not quite as fluently as Shirley, but with not too much difficulty. All this time Mrs. Clark gives no indication as to which answers are correct. Her main concern seems to be to listen to the students using the words. She reminds the class again, "You have to be able to master the words and put them in sentences."

Finally Mrs. Clark selects one of the boys: "Give me the answers to the first three questions, and I think we'll have what we need." Then she asks the class to turn to page 239, to the phonetic spelling of three bacteria types. In turn she asks a number of students to read: "coccus (KAH-kuhs), bacillus (buh-SIHL-uhs), spirillum (spye-rihl-uhm)."

Then a sudden change of tone. "Right," she challenges the class. "Right, all bacteria are harmful. Right?" There are some murmurs of disagreement. "You mean they're not?" Mrs. Clark asks the class. When it is clear everyone has grasped the question, she collects some answers, again without commenting on them. The students suggest that bacteria can take nitrogen from the air and make nitrate, that they can make organic matter decay, and some other things that are useful rather than harmful.

"We know that all bacteria are not harmful," Mrs. Clark exclaims, "but it isn't enough just to say it. You've got to be able to convince me that you know what you are talking about. When I asked you the question some of you said, 'No-oh.' I know from how uncertain you sounded that you don't know what you are talking about."

"Now some bacteria are harmful. Can you tell me about some of those?" The students make several suggestions, including scarlet fever. Mrs. Clark comments, "I don't just need the answer. I want to know the source of your information." Someone says page 240 and reads out the relevant section. Mrs. Clark says to the student who first answered, "You knew the answer, but you didn't know the page number. This is what we refer to as being scientific. You must know the source of the information."

The next problem Mrs. Clark raises concerns the growth of bacteria colonies. "Every twenty minutes we have new cells. How many do we have after four hours?" "128," someone answers. "Look at it seriously," Mrs. Clark urges, "Read that paragraph again carefully; and as you do so, I want you to become fully conscious of its true meaning." There's a pause. One of the students says, "After two hours there's sixty-four cells." Mrs. Clark says, "But I believe the author asks you to go on--if there are sixty-four cells after two hours, how many will there be after four hours?" "128," someone says. "Let's look at it seriously," Mrs. Clark urges again. "You've only scanned this paragraph. Would you read it with concern and then give an answer." There's another pause. "Yes, sir," she says to a student with his hand raised. "Multiply by two and you get 128." Mrs. Clark turns again to the text, "It says one cell gives you eight cells in one hour, and sixty-four cells in two hours. So how many do you get in four hours?" One of the girls begins thinking out loud, "In the first hour you get eight, and in the second hour you get sixty-four. So you get more in the second hour than you do in the first hour." Mrs. Clark encourages her to continue this line of reasoning, "Right, so . . .?"

"I have 256," someone offers.

"4026," someone adds.

"456," another.

Mrs. Clark tries to help out. "It's more than 2000. Sixty-four times sixty-four gives you what? The main issue is, you can see why the doctor quarantines you when you have a disease."

"3056"

"Four thousand and . . ."

"Four thousand and something," agrees Mrs. Clark while several students hurriedly try and work it out. "It's more than 4,000; close to 5,000. We can see how bacteria multiply, all right. We can make use of them, or they can be harmful to us. We can make cottage cheese out of milk if we are thinking about our waistline. Milk is a liquid. If you let it stand the cream comes to the top, and the milk is a liquid that will congeal like jello congeals when you let it stand. The cream can be churned to make butter, and the milk

congeals and can be cut into layers." Seeing the expressions on some of the students' faces she adds, "You don't like cottage cheese, right? Mother gets it because she is watching her waistline. Milk comes from what animal?"

"Cow."

"And cheese comes from?"

"Goat," someone suggests.

Mrs. Clark changes the topic: "Let's talk about something else--parasites, saprophytes. What does a parasite do to a non-parasite, the animal or plant it is living off? How does the parasite make its living?" Chris says: "It lives off another plant or a rotten tree or something."

Mrs. Clark repeats the question, emphasizing she is asking about parasites rather than saprophytes. James suggests: "A parasite lives off another living organism's life substance."

At this point the text says merely that fungi are parasites or saprophytes (though the previous chapter included a paragraph elaborating the distinction between them). Mrs. Clark, however, chooses to extend the point further: "Parasites are sucking the blood out of another plant or animal, right?" She pauses. "Look in our community at persons who aren't doing what they should be. If we are doing all we can to beautify the neighbourhood by cleaning up the yard and planting shrubs and someone comes along and leaves litter, are they parasites?"

"Yes, ma'am," someone replies.

"If people are living on welfare and are not fully participating citizens, are they parasites?"

"In a way," a student replies.

"Explain that," Mrs. Clark asks.

"It may be all they can do," the student says.

"They may be old," someone adds.

"They may have been in an accident," someone else says.

Mrs. Clark accepts all these qualificatiosn. "This is not a parasite, OK? If they are doing all they can and have paid their social security, it is all right."

One of the white girls asks a thoughtful question: "We're living off our parents, so you could say we were parasites." Mrs. Clark replies:

I don't want to make you parasites. Society owes you something, your parents owe you something. You have a right to education. But if you don't use your education and come to school and fool around, then you're a parasite. You are helping this community grow, but the person who sits around and doesn't work when there is work available, that's a parasite. As long as you are in school, your parents owe it to you to keep you, just like the federal government owes you social security. But over and above that we know there are people in school, in the church, and in the community who do not take a full part. In school there are those who fail to enrich the school program--at this point they become parasites.

An important feature of Mrs. Clark's lesson to this point is that she has made very few comments on the answers students give to the test questions. In her class this is done by students' challenging the answers given.

One of the boys says: "I'd like to challenge number three on page 241."

"What did the person say?" Mrs. Clark asks.

"It was Shirley; she said 'roots and stems' and the text says 'bacteria lack chlorophyll.'"

Mrs. Clark replies: "OK, let's look at the higher plants. What are the structures?"

"Stems, roots and leaves."

"OK, so what is the challenge?"

"It says 'true tissue,'" someone suggests.

"Root is a true tissue. It's a structure and an example, OK? What is your challenge?"

"It says bacteria belong to a group of plants that lack true tissue like roots and stems," Shirley reads from the text.

"And your challenge?"

"Chlorophyll. It says on page 241 that bacteria lack chlorophyll."

"Stems, roots and leaves is the right answer. Give yourself credit for true tissue. Are there any other challenges?" Mrs. Clark asks.

Two more challenges in the nature of competing definitions are offered before the end of the lesson. No points are awarded for success. In one case Mrs. Clark offers someone a choice, "Do you still want to challenge, or are you asking a question?"

Comments. Mrs. Clark is a charismatic figure in class. The students watch her as she teaches, and she uses her voice to considerable effect, altering its tone, intonation and pitch. She is the kind of teacher who would hold the students' interest whatever topic or subject she was teaching.

In this lesson we can see her using the device we have seen before in Mrs. Griffin's class of elaborating the parts of the text that have some interest value outside science (here it is such things as the cheese-making process and excursion into the topic of social parasites).

Perhaps most striking is the way she stresses the students' oral expression. When they read, she listens, not just for the correct answer, but for the fluency and facility with which students use scientific terminology. This combination of teaching from the text and stressing oral expression concentrates attention on the task of defining and labelling terms. It is a well-tried teaching technique, particulary developed in religious communities. Much Jewish and Moslem teaching has traditionally been of this kind. It is perhaps not surprising that respect for the text and an emphasis on oral expression should remain at the centre of educational values in the Bible belt of the United States.

It is important to point out that Mrs. Clark does not use the text as an instrument of propaganda, for students are able to "challenge" answers; and the fact that the teacher often refrains from giving clear indications of correct answers means that this is a lesson where students are encouraged to think and to reason for themselves. The example of the student raising the question of students being parasites is a case in point.

The link between the culture of the classroom and the culture of the church seems, in this case, to be one of style rather than of ideology. Mrs. Clark is teaching science as though it were a language and using the book as a text, in a style which has its parallels in the Sunday School. Formally, church and school are separate (though three flags fly outside the high school; the United States flag, the state flag and a Christian flag). Though in a community where social life is largely dominated by the churches, and where the life of the churches retains a strong educational element, such continuity may be a key feature in the culture. Similarities and continuities between the cadences and tempo of classroom and Sunday School may connect to an oral tradition that is deeply incised in the imagination of children. The curriculum analyst may seek the replacement of existing styles of science teaching by a "discovery" or "enquiry" approach, and the related changes in the performance of the teaching role that follows. The effect of success in this enterprise may be to cause a disjunction between school and community, the detail of which must remain highly speculative.

The Voices of Students

Visiting Mrs. Clark's science lesson left me feeling that I had not adequately touched on what made students interested in science, as opposed to just liking science lessons. In order to pursue this point further I talked at some length with a small number of students in both junior and senior high schools. Accounts of a number of these conversations follows.

Tony (Seventh Grade). Tony lives out in the country with his mother (who is divorced). He loves the outdoors and spends much of his time fishing and hunting. While he sees school as important, he sometimes talks as though coming to school was a tiresome chore between fishing trips, a price to be paid rather than a positive attraction. His mother explains that there was a time he lived in town, but that "No one was ever more pleased to move back to the country. He often says to me, 'I never want to think of going back.'"

Tony is very enthusiastic about science. He is a bright student who consistently gets good grades and he feels science is his best subject. He likes science because it is close to his interests and what he knows; because "there is more to do in science than in other subjects," and because "you learn about different things." Tony says, "Science is not easy; there's a lot of studying, but it is interesting."

He is an avid viewer of Cousteau films and "Wild Kingdom," and thinks perhaps he would like to be a marine biologist. He told me about a sea fishing vacation in Florida including detailed descriptions of the habits of sharks, sailfish and dolphins. He is very observant, and an eager collector of information. He likes to read the encyclopedia entries on the different fish and animals he encounters, and at home he has built up a small collection of books on animals and fish.

Part of the fascination of the outdoor life for Tony is "just the different things you see. When you go out in the woods you never quite know what you will find." It might be a raccoon eating fresh-water mussels, a deer, or a beaver building a dam. Fishing, especially, is almost a science to Tony. He's noticed that catfish and bream take different

kinds of bait according to the time of the year, the weather, the time of day, and a host of other things, including the phases of the moon. He seems to store each of these facts away in his mind as he encounters them, and enjoys the opportunity of talking to knowledgeable adults about them whenever he gets the chance.

The world of science has a tangible quality for Tony, not dissimilar to the world of the woods and creeks he knows best. It is a sense of reality few people possess and it carries with it a slight feeling of isolation. The world of hunters and fishermen is a world of the adult male, and is often alluring to teenage boys; Tony's grasp of a deeper quality that carries over into the world of science is more rare, however. He seems well on the way to appreciating some of the abstract qualities of the world of science, whether he continues with his formal education or not. It may be important to note that his science teacher is a woman, but she shares and understands his background. She explained to me, "I was an only child and had to be a daughter to my mother and a son to my daddy."

I asked Tony if he felt he could learn more about science by staying at home and exploring the woods and creeks. His answer, surprisingly, was no; a lot of science you couldn't learn from experience, at least in this part of the country. He felt science was not just about the immediate environment, but provided a window on a wider world. One of the things he liked about science was that it did provide some escape from the constraints of his limited world. He summed up his feelings saying: "Math is just a bunch of numbers, English is a bunch of words, but science is different. Science changes, you move on, you don't stay on one thing."

Bill (Eighth Grade). Bill is a student of few words, and he doesn't use those to say good things about school. It's not that he doesn't like school, his feelings are less active than that. School is just time that has to be served when he could be doing more interesting or more useful things. When asked to describe his ideal school he said, "It wouldn't be worth coming. There'd be no math, no science, no English, no social studies . . . well, social studies maybe."

Out of school he works on a farm and most enjoys driving the tractor; but overall, farming offers little more attraction than school. "Working in the garden don't seem worth it. It's a lot of trouble and you don't seem to get out as much as you put in."

The oldest of three children, his ambition is to be a truck driver. Four years seems a lot more school to wait out till graduation, but he has no plans for dropping out because his parents would be disappointed in him. A more immediate ambition is to own a car.

The one bit of the academic curriculum that seems to have reached him is social studies, but in the end it is still school. "It's all right to hear about the constitution and history and all that, but then you get a test and it's dull. You can often remember things when you want to but then you go into a test and get some dumb question you can't answer." Although social studies was his worst subject last year, this year it's his best.

On reflection, his ideal school would have less tests and it would all be computers; "You'd come into school, mash them buttons and away you go." "That's right," said his science teacher, "just like driving a tractor."

Steve (Eleventh Grade). When I asked people if there were any students who studied science out of school, kids who had chemistry sets at home and that sort of thing, everyone said I should talk to Steve. From the way students talked about him, it was obvious they felt he was a little different from them. He actually lived in a world of science and liked to speculate and talk about those things.

On first meeting, he explodes some of the stereotypes. Yes, he does feel a bit isolated in his interests; but he is also a 180-pound football player and champion weight-lifter; activities that have won him a position of some respect in his peer group.

He lives out in the country and is an avid collector. He collects coins, old bottles and books. He has a library of science books, reference books and science fiction (Asimov and Tolkien are his favorite authors) but he talks too about H. G. Wells and Thor Heyerdahl, whom he admires considerably. He reads Popular Science and Popular Mechanics regularly, and also subscribes to a Science Book Club. He has a chemistry set and a geology set and analyzes rocks for fun. At Christmas he plans to get an optics kit. He builds and flies model rockets and model airplanes in a scheme organised by the Civil Air Patrol.

His interests are wide, but he most likes chemistry and math. "I've grown up around numbers," he explains; "Daddy is a clerk and I've always watched him work with figures. It always puzzled me how he could keep track of a sheet of numbers that was longer than I was. I couldn't see how he did it. So I sat there and watched him work with a sheet of numbers and a slide rule until I had it figured out." He adds with a smile, "Now in algebra I'm working with letters instead of numbers and my dad is working with a calculator."

Janice (Twelfth Grade). Janice is one of a family of six children. She has two older brothers who are both in college, a younger brother and a twin brother both in school, and a sister who died suddenly just before leaving home to go to college. Janice also has a baby boy born last summer. The family lives in a small wooden house in one of the two main black areas of town.

Janice is taking elective courses in advanced math, chemistry and home economics. She says:

> *I chose home economics because I wanted to learn to cook and sew and look after myself. I chose math because I liked it. And I chose chemistry because I thought I needed it.*

She has always liked math ("to tell the truth it's the only thing I ever have liked"). She has never had to work too hard at it ("my mother thinks I don't study for it because I don't bring no books home!"). Even when she has missed lessons, she hasn't had too much trouble making up classes.

She prefers to do math problems in school rather than at home, "because there are always people around you if you get stuck." But she is not too keen on working problems at the board ("I don't mind too much, but when you are up there in front of all those students you get scared you might get things wrong").

Although she has not had any trouble learning math, Janice never thought of herself as an outstanding student ("I never wanted to compete with all those A students"). In fact, she planned on giving up after Algebra II, but a guidance teacher persuaded her to continue.

Chemistry was a bit different. Janice had really wanted to take physics, but too few students signed up for it. Her brother told her she should try and take science and the guidance counselor encouraged her. After the first few weeks she tried to get out; "I was scared I couldn't do it," she said, but the counselor persuaded her to stay and she now feels that was a good decision. ("Now I'm doing pretty good and I like it.")

A lot of students are scared of math and science courses, she feels, because everyone thinks they are so hard. "Students think if you are taking chemistry and advanced math and geometry, you're taking the hardest courses and you must be really smart." Janice says she once felt the same but now she doesn't feel it holds much truth--"a lot more students could do math and science if they wanted to."

Keen Competition

Although the high school claims that its students are not tracked, there is a sense in which the curriculum contains elements of a selection system. Some courses are designed for the college-bound, including the higher level math and science classes. In these classes, competition between students often takes on a finer edge.

Mr. Rodgers' Physiology Class. Mr. Rodgers teaches biology (three classes a day) and physiology (two classes a day), both of which are electives. He admits this makes life easier: "The students are here because they've chosen to be here and they get on with the work."

For the teacher, a possible disadvantage of elective classes is the wider age range you get in each class; but Mr. Rodgers doesn't find this a problem. On the contrary: "I like mixture of ages you get because the ninth grades look up to the older ones a bit, and I find that makes it easier."

The other feature of elective classes is that you tend not to get such strong friendship groups in each class. ("In the second and fifth periods I've had to seat them alphabetically because there were too many friends sitting together, but it is more unusual than in required courses.") Mr. Rodgers echoes the feeling of other teachers about discipline: "There are no real problems this year. The girls are more of a problem than the boys for talking in class, and sometimes talking back to you, especially in the ninth grade."

Amongst students Mr. Rodgers is known as a teacher "who makes you work hard." "He expects a lot of you," one student said; and a parent went so far as to describe him as a "disciplinarian," but her friend felt this unfair. "He's very close to the students. I believe he's the first teacher they go to to get advice about their love life!"

What's it like to be in Mr. Rodgers' class? Let's look at a physiology lesson. Period three on Wednesday, in mid-November. Mr. Rodgers has the only classroom in the school that is even minimally equipped as a science laboratory--four benches down one side of the room, a shelf or two of assorted glassware and a rack of jars holding pickled snakes and reptiles ("We used to have more," explains Mr. Rodgers, "but once we had a break-in and they were left strewn across the room").

Most of the room is conventional classroom, the space taken up by some thirty-five desk-seats. Immediately, however, you notice another advantage of elective classes, for in this physiology class there are only eleven students. Elective courses are not necessarily taught in small classes, but they often are (ten is the minimum class size as a course to be scheduled by the principal).

Mr. Rodgers starts the physiology class with a spelling test. He reads out eleven words (examples: "autonomic nervous system," "proprioceptors," "neurolemma," "neuralgia," "myelin sheath," "excitability," "summation"). Ten minutes later, he collects the papers without comment and begins a recitation concerning some work the students have already completed. Each student is given a turn to answer the questions. It's a bit like a quiz. Mr. Rodgers reads out the questions, and if they get five in sequence correct, they score a point. If they get it wrong and can't answer, it passes on until someone gets it right, and collects a bonus point. Sometimes the questions go round the class (with mounting excitement) until someone scores. Almost all the questions (which come from the textbook) concern terminology or definitions.

"What are three characteristics of the nervous system?"

"What's the difference between a threshold and a sub-threshold stimulus?"

"What's the difference between the nervous sytem of the amoeba and the human?"

The answers come back in the stylized rhetoric of the textbook. Clearly the essence of the task has been to search the text for the sentence which contains the correct answer. Jane calls out in complaint, "Mr. Rodgers, you missed my turn!" Carla gives a particularly involved response to a complex question. Anita comments, "She must have asked her doctor" (is Carla the doctor's daughter, I wonder?). Mr. Rodgers says, "If you get them right, I don't care how you got the answers."

The whole thing is good humored and even exciting. One of the two black girls in the class turns her head from the action and appears not to want to take part (though when her turn comes she answers and gets most of the questions right).

Peter (who had ad libbed earlier questions) gets a long question about the transmission of nervous impulses. Instead of the customary text-style answer he simply says: "All or nothing." Angela, the girl in front of him, cries out full of mock indignation: "He looked at my book. He looked at my book. That's not fair!" Mr. Rodgers looks at Peter, and for the first time asks, "But what does that mean?" Peter hesitates but is saved by his friend: "He got it right. You've got to give it to him!" "That's right," someone adds, "You said you don't care how he got it so long as he got it right!" Mr. Rodgers graciously concedes the point, much to the amusement of the class and Angela's feigned disgust.

Halfway through the period Mr. Rodgers switches to a handout the students have been working from. This is a simple duplicated sheet with a diagram and some multiple-choice questions. The teacher reads out the questions and the students call out the letter indicating their answer in turn. The effect of this on the pace of the lesson is to quicken the excitement, especially when students get a succession of wrong answers and the possibilities of guessing right increase.

Mr. Rodgers reads: "Carries a motor impulse."

"(j)"

"Norma"

"(i)"

"Roger"

"Ooh this is 17, right? Oh (c)"

"Carla"

"How about (g)?"

("Someone already said that," someone calls.)

"Faye"

"(k)"

"Right"

"Oooh!"

"She's got a point! Her first point!"

In the next extended sequence, one of the black girls shakes her head and says, "Don't know." "Just give one," encourages Mr. Rodgers. Norma gets the next point by an obvious guess. "I hope your conscience bothers you," mutters one of the girls.

Some of the later questions require only "true" or "false" answers, increasing even more the chance of success by guessing. The groans, whoops of surprise, and lucky wins increase. Anita guesses one right but then Mr. Rodgers remembers she had forgotten to bring her paper to class and cancels her point. (By implication a new rule is established --you can guess and gain a point by a lucky right answer, but Mr. Rodgers explains you must do the work and bring your materials to class.) With ten minutes of the period to go, the checking of the work is complete and Mr. Rodgers quickly dictates some notes on the classification and function of nerve fibres:

"C fibres are the fibres with the smallest diameter and the slowest conductance --just one mile an hour."

Someone says: "But there isn't a mile of nerve anywhere in the body."

Mr. Rodgers explains: "That's just to give you an idea of the speed."

He dictates fast and the temperature of the lesson subsides. The humor remains, though:

A fibres conduct pain--so when you're sitting at the football game, that's how you know your feet are getting cold! [Last week's game was played in record low temperatures.]

Comment. Motivation is clearly no problem in this class. Not only are all the conditions right (a small, elective class), but Mr. Rodgers is skilled at judging the pace of the lesson and the climate of the class. The mood is one of good humor and enjoyment; he clearly enjoys the lesson as much as they appear to, always being relaxed but totally in control of what is happening. At the end of the hour it is almost a surprise that the time is up and how much work has been covered.

In emphasizing the way the class was taught, I may have neglected the content at the cost of emphasising competition for grades. On reflection it would seem the students would probably learn a lot in the way of terminology and definitions from this class. The "game" element I have described seems to have been treated with amusement by everyone (except possibly the black girl who remained relatively uninvolved). It might be a mistake, too, to think of "the game" as obtrusive, because throughout it was treated lightheartedly by everyone.

What did impress me was the ease with which Mr. Rodgers conducted the class--the spelling test to begin which (not too long) concentrated the attention of the students. The class response to questions, quickening through to the multiple-choice and "True-False" questions. Finally the short, rapid dictation, which brought the class down again before they left the classroom. In many ways a model lesson of its type.

At this point it might be useful to look briefly at another elective class in another subject to check whether student motivation is generally a problem in such classes, or whether the class we have just considered is exceptional.

Coach Williams' Algebra II Class. Like Mr. Rodgers, Coach Williams (who is also the assistant football coach) teaches mainly elective classes. When he first came to the school six years ago, the advanced math program was a single Algebra II course. Now there are two Algebra II classes, advanced math and geometry. Recently Coach Williams has persuaded the junior high school math teachers to offer algebra in the ninth grade, and next year hopes to start a pre-calculus course in high school.

> *We've only had pre-college math for the last two years. This year we have fourteen [fifteen] students taking advanced math, twenty-two taking geometry and nearly thirty taking Algebra II.*

Especially surprising, given national figures, are the numbers of girls in pre-college math classes--nine out of fifteen in advanced math, for example, four of whom are black. In the Algebra II classes I observed there were ten students (but another eight were out of class for 4-H club).

Currently the class is working on the simplification and multiplication of algebraic fractions. Mr. Williams takes the exercise they have been doing, assigns each student a problem, and they write their solutions on the blackboards. (There are boards on two walls of the room which gives each student plenty of space.) Having displayed their solutions, they return to their desks and Mr. Williams proceeds to go through each one in turn.

Each student describes how his/her approach to the problem and talks his/her way through the solution step-by-step. Obviously this is something they are used to doing and they talk easily and confidently about denominators, quotients, factors and terms. All the descriptions are accurate and precise and used with economy. Mr. Williams lets errors pass and tries to get the class to discover them:

> *"I don't understand how that can be," Jane comments on a student's solution. "How do they cancel out?"*
>
> *"Good question," adds Mr. Williams, "can you cancel from numerator to numerator? No? Right."*
>
> *"So his answer's wrong?" Jane asks.*
>
> *"Correct."*

On the other hand, Mr. Williams will often extend and elaborate an answer by giving counter examples. His style of teaching is marked by total fluency with the material. When difficulties do occur, he rapidly works back to a point where the students understand what is happening. For example, when a student has confused the sum of two squares with the difference between two squares: "Is subtraction commutative? [pause] Remember when we did this before? [pause] Is a-b the same as a+b? [pause] Is 5-4 the same as 4-5? No. Right . . ."

He reserves special delight for the elegant solution:

Eight and ten are good test type questions. They evaluate you on how well you can simplify and they evaluate you on how well you can factor. They're difficult but they're not beyond your learning.

As in Mr. Rodgers' physiology class, the game element seems strong; but here it is more muted. If the physiology class was essentially a quiz, AlgebraII is a game of strategy. Here getting the right answer is not as important as the elegance and economy of your approach to it. At one point someone makes two errors and yet somehow ends up with the correct string of terms on the bottom line.

"Would she have got it right on the test?" Chris asks.

"No," explains Mr. Williams, "because the procedure is wrong. The answer is not important; it's the procedure. You could get the answer wrong and still get nine points out of ten. Do you remember when we discussed this at the beginning, when we talked about the fairest way of marking problems?"

If there is an air of competition, it is not so much between students as between the mathematician and the problem. When a problem is solved, Mr. Williams gives praise; but he tries to make it objective rather than personal: "A good problem. I worked out real good." And towards the end of the lesson, when he wants to move on to the next section of the text:

"I want to go on to the next thing--division of algebraic fractions."

"But some of them are away," Annette remembers.

"This is so easy they'll soon catch up," jokes Mr. Williams.

"So tomorrow we can sit back and take it easy," someone replies.

But at the end of the class, Mr. Williams returns to the point:

"Don't tell the others what we've been doing because they might think it's difficult. Remember how important first impressions are. . . ."

Both the classes we have considered have been elective classes for the more academic students who represent perhaps 20% of the high school population--those who aspire to university or four-year college on graduation. These are the students you would expect to be most strongly motivated in class. They are, after all, the ones who apparently have most to gain from success in school.

A NEW GENERATION

The pages that follow are extracted from conversations I had with eight high school graduates. They are not typical, since they represent the 20% or less of students who have gone on to college. But what they said seemed to me important. Deciding how to present what they told me was difficult. Each had a different story to tell. In the end I chose simply to select, condense and summarise what each of them said, leaving the reader to draw inferences and make some sense of the total.

Dave

Dave is in his first year at State University, studying criminal justice. Son of a Post Office administrator, he spent the eighth and ninth grades in Pine City Academy before returning to the public school system.

Dave was class president in his senior year, entered the co-op program and served as a state officer in the vocational education club. He felt the program was a valuable one, partly because it "keeps a group of students in school who would be working anyway," partly because he enjoyed his work as a local radio disc jockey.

He didn't take general science but went straight into biology in grade nine, a move he now feels was a mistake: "It was really a course for tenth- and eleventh-grade students." To some extent this experience put him off science, though he has just done an earth science course at college which he enjoyed.

I knew by ninth grade I wanted to go into criminal justice so I found myself asking, "why biology?" It's a question a lot of students ask themselves. Why science? And it's not a question that school really answers. I think teachers need to bring out the practical uses of the subject more, that would help. Though I don't know to what extent.

He agrees that many Pecan County children have an extensive knowledge of natural history. "Kids here know a lot about how to scale fish and the different parts of the fish, and the same with squirrels, deer or whatever. But the teachers never bring this into science. It's like two quite separate things."

The main exceptions were when he had to make collections of insects and leaves, though it seems this was ultimately an identification and labelling exercise rather than anything else.

This does not mean Dave would have preferred an open, exploratory kind of curriculum. He likes teachers who closely follow the book. "I'm small town. The books are written on a real high level." He felt the teachers' interpretations or extensions of the textbook were often confusing or inaccessible, and that they should have stayed closer to the text.

Dave had a number of misgivings about testing. He felt there was often a large gap between what students understood and what the tests measure. "Students often learn a lot more than teachers realise. I don't see how you can honestly test a student on his knowledge when it's really the teacher's knowledge you are testing. The teacher gives what he knows and then gives a test to see if the student knows it. To be a teacher he has to know more than the student to start with, or the student would be teaching the teacher. I see giving tests as a way of learning but not as a way of <u>grading</u> a person." Some of his teachers, he felt, were concerned to discover what the students learned and understood rather than simply how they scored on tests. He singled out Coach Williams, the math teacher, and one of the social studies teachers.

They gave you credit for the way you did things rather than for the answers. Coach Williams would go through a problem step-by-step and give you credit for the tests you got right. If it wasn't for that, no one would have passed math!

The main problem he feels is "right and wrong" tests because "these discourage people, and students do get discouraged by test results."

Tom

Tom took high school courses in Algebra I, geometry, Algebra II, advanced math, general science, chemistry and physics. He is now an engineering student at State University on an ROTC scholarship. Although he took a wide range of math and science courses, it was drafting that led him to engineering.

Drafting was a course he "wanted to try," and several of his friends took it, too. Once into it, he got more interested and wanted to go further, but felt the teacher was handicapped by the students in the class who thought it would be an easy option:

The students who wanted to get on were outnumbered by those who just thought it would be easy. We could have done more in the way of practical applications. The teacher wanted to do some surveying, but too many people were not interested, and it would have been difficult and perhaps led to discipline problems. He was going to teach us to use the slide rule, but again not enough people were interested.

Like several of the students I spoke to, Tom felt more comfortable with math than science, and, within science, with physics rather than other areas of science. Chemistry especially he found hard: "General science was physical, you could almost put your finger on the phenomena; but chemistry was very abstract."

It might seem strange that algebra and advanced math can be tangible, yet chemistry seem abstract; but perhaps this indicates a particular form of imagination, and perhaps of intelligence that seems natural to an engineer, if not to others. The way Tom described it, the thing about math and physics (and drafting) was that you could see things in practice. He got a part-time job in the textile plant where his uncle was a maintenance engineer and there saw a lot of the principles and machine parts working. Chemistry, though, was "like another world" and he felt it was harder to imagine the phenomena.

In the engineering course he was following, the instructors seemed to be making an attempt to build in some sense of relevance. Already they had talked about energy conservation which, through government regulation and public concern, was becoming an important factor for mechanical engineers. The course had included a visit to a house heated by solar energy. The introduction to electrical engineering had begun with medical applications: EEG's and ECG's, rather than with theories or simple circuit boards. In addition, Tom was required to take courses in world history and in "technology and civilization." So it seems that there is some evidence that this college at least is responding to some of the criticisms voiced by John Stephenson (see "Other Voices" section).

Reflecting on the quality of his education overall, he felt there was a tendency not to think too far ahead, perhaps not much "beyond the next test." He wasn't clear about courses he would take next year.

Maybe that's just the American way [he added]. Sometimes I'm not sure if it's a very good way because you tend to learn where you go to find something out rather than how to do it. Like square roots. I don't know how to find the square root of a number if it's not a perfect square because I've never been taught. The instructors tell you there's no need to know because you can always look it up in a table. I'm not always sure about that, but maybe I should have tried harder to find out for myself from books.

Carol

Carol graduated from high school two years ago. She is now midway through a nursing degree at State University. She, too, found math easier than science: "Math was easy, I just breezed through it." Science, she felt, was harder, and she remembers the Bohr atom models of reduction and oxidation as "kinda confusing." When she had difficulties understanding, she tended to talk to other students about them rather than the teacher, but felt the most important thing in any course is "to get an understanding with the teacher." In one course she found hard in college, she felt the main problem was that she couldn't "get along with the teacher."

She did not find too much gap between high school and college courses in biology and chemistry, but wishes she had had more lab work in school. "It makes it more interesting and easier to learn." In her senior year Carol went into the co-op program. If she hadn't, she would have taken advanced math; but faced with the decision, she stayed with the co-op scheme: "It was my first job, the experience was useful, and so was the money!" That seems to be about the order of importance of things for Carol in making the decision, and after all, she already had more than the math she needed to enter nursing.

When she graduates, she thinks she will work out of state (for the experience), though probably in a small town rather than a big city. "I know the wages are lower but I like small towns. I'm kinda slow myself!" At least to start with, she doesn't think she would want to return to Pine City, though the difficulties of breaking through the segregation that still exists in the town hospital is not the major reason. "That'll probably change," Carol says. "I'd just like to try working somewhere else."

Gail

Gail graduated from high school last year and is now a student at State University studying psychology. The oldest in the family, she has a sister in ninth grade and a retarded brother who's thirteen.

Her brother has been an important influence in her life. She has found herself looking after him in order to give her parents some break from the demands he has made on the family, and she has watched psychologists and doctors working with him. Consequently, her interest in psychology is practical rather than academic: "I'm not going to school because I want to teach psychology. I want to really do the field work, working with retarded children. I want to understand more." She feels that going to college is important because some of the people who work in this field are not qualified and however good they are with children, do not really understand the reasons for doing things. Nevertheless, she feels her experience is important because it has given her an understanding of retarded children she could not have gotten from books. "I've lived in it. I understand my brother. It doesn't bother me that he's like he is, but it upsets a lot of other people."

So far she is very disappointed in the general psychology course, which she feels is very dull and from which she feels she hasn't learned anything. "I like the films," she says; "I learned from them, but the book isn't anything like reality." Part of the problem for Gail is adjusting to the teaching method.

> *I'm used to being taught, but at college we have to read the chapters and then discuss them in a group of five students without an instructor. A lot of the students aren't interested and they just talk about parties and football games,*

and that way you never really learn anything. Next day there's a pop test, and every week it's the same routine. I didn't really learn anything except what I'm really interested in, like child behavior. The things I wasn't interested in I didn't read the chapters.

Don't the tests catch her out? "Well," she says, "the tests are all multiple choice and the words are in the text in italics; so if you just look through those, you can usually guess the answers."

At high school, Gail took courses in biology and chemistry, Algebra I, Algebra II, and geometry. She would have also taken physics and advanced math, but in her senior year chose instead to go into the co-op program. This meant she took two hours out of school to work in ladies' clothing stores. She admits she did this partly for the money, but also for the experience. "It's much easier getting a summer job when you're in college if you have some experience to offer."

She always liked math, even though "a lot of my friends wouldn't take algebra or geometry because they said it was too hard. It's the name that would scare them." She thinks this is especially true of blacks. "You don't find many blacks in math courses, or in chemistry; and if you do, they're the ones who are college-bound."

Gail always knew she was college-bound, even though no one in the family had been to college. "I was always told I'd go to college. I was always told, 'You go to school and get your lesson, and before you know it you'll be going to college.'" Her parents were a great influence on her; in fact, she sometimes wonders if she would have gone to college at all if it had not been pounded in her head so much. Her mother especially watched over her progress at school. "She just couldn't bear to see a 'C' on my report card. If there was, I'd be grounded, no going out and no phone calls." Gail says she tried hard to please her mother, maybe more than to please herself; but now that she is at college, that impetus is less direct. She is taking music as a minor option and a few weeks ago had to play to an audience of five professors. "The night before, my mother called and asked what I was going to wear! But this was something I did on my own. I got good grades and was very proud that my mother wasn't there! I did this on my own."

With home being such a strong influence, you might think it would be hard for Gail leaving Pine City. But she likes the social life of the university, and in some ways finds life in Pine City restricting.

Quite often when I'm depressed and need some excitement [she told me] I'll go and stay with my aunt in Detroit. She drives a city bus and I just like to ride the bus all day looking at people. For a country girl like me, that's real interesting! . . . When you come back, it looks dumber and dumber. I just think, what have I been doing here all my life, because it's so small. There's not really anything to do.

It would be wrong to think Gail did not have any sense of purpose while she was at school in Pine City. In fact, she only took science courses because she had long-term aims in mind: "The truth is I really don't like science. I hate it and I always have, but I was ambitious so I passed the courses. A lot of times you get into courses you don't like, but you're ambitious and you know you need it."

Three weeks into the chemistry course, she almost gave up. Her friends didn't help because they all told her the course was too difficult and she'd flunk out (none of them took it). Again it was her mother who made her stick at it, and in the end she enjoyed it, mainly because of the teachers (Miss Green and Mr. Rodgers).

I did enjoy the science courses, even though I hated science. I went in there with a negative attitude, but I did enjoy it. When the teachers are nice it makes it easier for you to accept them and the subject you're taking. I never did like science, but I enjoyed it more than I thought I would because of the teachers.

Like a number of students I talked to, Gail felt a clear distinction between math and science. The former she enjoyed and felt confident about (except perhaps geometry), but science was a different matter. In trying to explain the different intellectual demands that the subjects made, she said:

I enjoyed chemistry more than biology [in the end] because chemistry is more numbers. Biology was mainly learning the names of things. I was interested in the dissections but they were mainly to learn the names of the parts, not how things worked. But chemistry was more interesting because there was more explaining why things happen, and different theories.

The dissections and the little lab work they did she felt was useful, because "it made you feel like you were doing something. You got to see what you were doing. You really felt you were into something."

Jennifer

Jennifer graduated two years ago and is just about to graduate from a two-year college in the state's largest city some one hundred and fifty miles away. I talked to her about the relationship between education and employment, and between rural and urban life.

Jennifer was clear about the elements of segregation that remain in Pine City. "There's a big red line," she explained. Some restaurants will not serve blacks; there are two community centers--one black, one white; and a number of jobs are still closed to blacks: in the banks, the Power Company and Telephone Company offices as well as City Hall and the County offices. "It isn't because blacks haven't tried," Jennifer explained, for she had tried to get a summer job in the banks only to find unqualified white girls doing the same work. "They have a line," she said, "and it's going to take some pushing to get past it." In fact, she thinks it's going to take federal intervention.

Jennifer feels the only jobs really open to blacks are in education; but even there "blacks don't often get jobs beyond a certain level, whatever their qualifications." Overall, she says "we're held back. We can only struggle."

What is the role of the school, I wondered. Is the school system creating a generation of blacks who will not easily accept the situation, or is it helping them come to terms with the way things are? Jennifer didn't feel it was so simple and clear cut, but she admits she is ambitious and that she found the school mostly encouraging. "Round here you mostly don't see much progress, you just accept things the way they are, but school has helped."

If you are black and ambitious, you have to leave town. During the time I was staying in town, a black woman celebrated her one-hundredth birthday. That day you could see where ambition had taken people. The Holiday Inn was taken over for the day by blacks in furs and city suits; and outside, their cars (several Cadillacs) nearly all displayed Michigan tags.

Jennifer pointed out that there is a cost, too; for city living is quite different from life in Pine City. "Being in a small town you never meet any big challenges. Renting an apartment, finding your way around in the city, knowing how to make friends, all those things can be hard if you are not used to city life. Coming up in a small town you don't really learn to be independent."

In school, too, there are disadvantages that Jennifer has felt in competing with city girls. These are hard to specify, for though the curriculum does not offer just specialized courses, it is fair; and the faculty, though locally oriented, is well-qualified and competent. It is true that equipment is not good, and she feels perhaps the counselors are not fully aware of what is available in the city simply because they are distant from it and lack contacts.

As I talked to Jennifer I became aware of two intricately related aspects of disadvantage. The disadvantage of blacks against whites, and of rural against urban areas. "Perhaps small school systems need more money than cities," she suggested, "or courses in city living." Though as we talked, we agreed it wasn't courses that were needed so much as experience, perhaps through an exchange system or, more ambitiously, an urban studies center where students and faculty could work and study in a city environment.

Jennifer sees past the aspirations and the rhetoric of the Pine City school system, and what she sees is a small town system trying hard but still with a long way to go. And not all the barriers are outside the schools:

> *You can have a white instructor in school; you see him every day and perhaps you'll chat to them sometimes and maybe you'll get to know them a little. But you'll meet them downtown and there'll be an avoidance. Maybe they'll have their husband or their daughter with them, and I've even had them look straight in my eyes and not say anything. And nor would I, because you know that deep within there is still a certain prejudice.*

Jennifer is in a good position to have observed these things, for when she was in sixth grade she was one of five black students whose parents sent them to all-white schools under the doctrine of "freedom of choice."

OTHER VOICES

So far in this report we have looked at the school system mainly from the inside. In the context of the study it seemed valuable also to try to get some view of the schools from outside the system. The accounts that follow make no claim to be representative, but they record some of the voices to be heard within the community.

Rev. Gibson

Rev. Gibson shares some of the issues and concerns that face Mr. Tyson, the superintendent. He, too, is an outsider to Pine City who came into a difficult and delicate situation with an impressive reputation, having been involved in the Civil Rights movement in his church locally and nationally. Coincidentally, he and Mr. Tyson were friends from years back, having been in college at the same time.

Rev. Gibson arrived in Pine City at much the same time as Mr. Tyson and met similar problems. In his case, the immediate situation he faced was a major division in his church that had split families and created almost as much local debate as the desegregation of schools. Part of the issue was congregational as against church control, and Rev. Gibson came into the remnants of his church as the Church-appointed minister.

Like Mr. Tyson, he is a man of vision with the ability to translate his ideas into action; he has quickly established himself and become a significant voice in the city on many issues of importance. During our stay in Pine City an interdenominational service was held for Thanksgiving, said by some to be the first time whites had attended a black church except for funerals. It was significant that Rev. Gibson was chosen to give the sermon.

Perhaps unusual for a minister, his vision of the immediate future is primarily bounded by economic themes. He sees society increasingly dominated by public sectors of the economy rather than by the private sector; a movement to service industries which may well be accompanied, or quickly followed by, a slowing of economic growth. As a consequence, he sees the process of integration depending on the willingness of whites to make adjustments in their standard of living, to allow for more blacks to assume responsible decision-making positions in the community.

To date he feels integration has largely been achieved against a background of increasing prosperity, allowing some improvement in the living standards of blacks without too much cost to the white community. That stage of integration, he feels, may well be at an end; and the white community may be faced more directly with moral and social issues, as well as adjustments in their standard of living.

It is interesting to note that the prosperity that has made integration possible has also created tensions in the city, for it has created the new shopping plaza on the exit to the interstate highway, and has meant shifts in political control from the aristocracy to the business and professional community. (Ironically, some lawyers who constitute an extremely strong conservative force in the city are said to have made much of their money out of the legal jungle of civil rights cases and federal court hearings.) The effects of prosperity have been two-edged; they have made some changes easier, but have created others which in the long term may have considerable effect.

Rev. Gibson is well-informed about education, a confidante of the superintendent in times of trouble. His wife teaches part-time and he has one child in high school, with two older children having received their high school education in the public schools during the time of total integration. Looking to the schools, he sees the significant factors again as primarily economic. He feels the extremely low property taxes in the state and the low proportion of taxation headed for schooling as constituting a major educational constraint, and one he expects soon to change. Considering student attitudes, he admits that he faces similar challenges as a minister. The old and the very young constitute the bulk of the congregation in most of the city's churches, and he is concerned that between high school and parenthood a generation has drifted away from the churches.

Five Gospel Minutes

Whenever I asked people in the school system if there was any religious control over the curriculum, this was always vigorously denied. No one could think of any examples of pressure being brought to bear by churches, and those teachers who were teaching in controversial areas felt that, if anything, they would welcome more outside interest.

Driving down the interstate some two counties away, I heard a local radio broadcast in which a minister launched a major onslaught on evolution. He attacked "Humanistic thinking based on the theories of Darwin, which treats the Bible as just another document. This leads to a denial of God's truth and results in relativism." It was an articulate and powerful argument delivered with characteristic force.

The same week the Pine City radio station broadcast a service from Reverend Gibson's church. The sermon was a comment on the federal government's decision a few days before to continue with the development of a supersonic military aircraft.[2]

Mr. and Mrs. Smith - Parents

Mrs. Smith lives in a log cabin that has been in her family for near enough a hundred years. She has three grown-up children and another three in high school. Her husband is a carpenter but they also work the nineteen acres of land that remain as their share of the family farm.

To visit the Smiths is in some ways to visit the past. Though they have had electricity and the telephone for a number of years, many of the older ways persist, too. Their milk comes from a cow, not a carton; they grow the vegetables they need and much of their meat comes from the deer they hunt in the woods, or from hogs they raise themselves.

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[2]Rev. Gibson comments: "I used this only as one illustration in the sermon, seeking to depict the darkness of war threats, as part of the darkness which tends to put the light of truth brought by Jesus Christ out. My sermon was 'The Dark World's Light' based on John 1:5. I would not want to give the impression that my sermon was an attack on the government."

The young Smith children (two girls and a boy) are triplets. When the schools were desegregated in 1970, their parents could not contemplate private schooling because of the cost. "We might have been able to afford for one to go, but not three. It was hard enough finding the money to clothe and feed them." Watching them eat as they return from school, you can see what Mrs. Smith means.

On the whole, parents and children are happy with the way integration has worked out in the schools. It is not, perhaps, something they would have chosen to happen; but given that these things are decided by others, it could have been a lot worse. Looking back, they don't feel there would have been any advantage to private schooling.

The children are perhaps more sure than their parents. The girls are energetic and confident and look likely to make the best of whatever situation they put themselves in. John, their brother, is less extrovert and his life revolves around the farm and the woods, rather than friends and school. He is another of those kids who has a remarkable knowledge of the natural environment and likes nothing better than "hunting or just running wild in the woods."

There was a time when his kind of background would be thought "narrow" and limiting. These days, with cars, with the world shrunk to a village via television, and the county to a family via the telphone, "narrow" doesn't seem the right adjective. It seems families like the Smiths have all the advantages of living in the country, the community life that comes from neighbors and the church, and access to many of the things that in earlier days only city dwellers had.

It might be thought that integration would be easier to achieve in rural areas because blacks and whites were more used to each other. This doesn't seem to be true. Pine City has black sections, but it is not big enough to have black ghettos like the big cities. And in the country, too, residence is often segregated. Indeed the school buses are often predominantly "black" or "white," and students use those adjectives to describe them.

Although it is true that in the past blacks and whites often worked together, habit and custom also kept them separate. Churches are quite separate, and we have already seen how one teacher remembers as a girl being kept in the house when the blacks returned from the fields. Since the plantation days, so many of the farms are part-time enterprises employing only family labor that the "closeness" of blacks to whites in the country is probably exaggerated.

Accepting integration in the schools has been no easier for the Smiths than it has for families who live in town.

Preston Ward - Local Industrialist

Preston Ward is a manager of a manufacturing company which produces protective gloves. He is also a city councillor and generally considered to be an important man in the town. This in itself reflects some of the social changes that have occurred in the town in recent years. Someone comments, "It always used to be the aristocracy who ran things here, but having men like Preston on the city council has meant big changes for a lot of people."

The company Preston Ward manages is part of a group based in the North; but it is run as a "profit center," and for most purposes could be considered an independent enterprise. It has been in the town some fifteen years and occupies a building previously used by another textile company. The present plant employs around 600 people, mostly women machinists who stitch the gloves together. By some standards it may seem a small plant, but with a pay roll of $1.5 million a year it represents a major feature of the local economy. (The school board superintendent pointed out that he'd heard local finance and loan agencies soon knew when business was bad in the glove trade.)

The work is piece work, and the rate of pay standardized for each job. The ethos of the plant is dominated by speed, efficiency and an air of competition. The machinists work at remarkable speeds, colored ribbons above their machines advertising to all how far above the standard level of output they are working. Each works within easy view of a clock, while charts above them indicate the quality level of the output and the number of accident-free days that have been worked.

How does Mr. Ward see their job?

It's not a job people aspire to, more one they end up doing. I don't want to imply by that, that they are in any way poor workers because we have a fine group of people here, and it's not an easy job to do. They have to take selection tests for this work, and we have to give them quite a long training program. [It takes about six months to learn the job.] But we have to face the fact that if you went up to the high school and asked the students if they saw themselves working here when they graduated, there are not many that would. Most students aspire to something they feel is a little better, and I think it is quite right that they should feel that. The job the women do here is one they come to maybe after they've had children, or they've tried other jobs since leaving school.

Recruitment is often through families or friends:

We have families and we encourage them. Husbands and wives, mothers and daughters, sisters, aunts and cousins. It's a happy place and they are fine people.

This judgment is borne out by staff turnover figures (2.5% annually compared to 5% per month in the state as whole), and by the good-humored and easy way they leave work at 4:30. Almost all the workers are residents of the county, and they tend to be country rather than town people (about 75% from the country, Mr. Ward estimates). Commuting twenty miles a day to work is quite common. Has the nature of the work force changed much in recent years?

Well, we used to schedule for 96% attendance, now we average out about 92%. [But Mr. Ward adds] There was a time when you could say to someone, "Be here," and they'd be here, come hell or high water. You can't do that now, and it's right that you can't. Some managers used to run their plants that way, but it isn't the right way to treat people. It isn't right now and it wasn't right then.

As manager and as an employer, what does Mr. Ward see as the function of the school system?

The right attitude to work is what we need, not specific training for the job. If industry gets people with the right attitude, we can teach people what they need to know, probably better than the schools, because we can teach them on the job.

This might be seen as a criticism of the vocational and trade schemes in the high school, but Mr. Ward does not see it that way:

I don't want to be seen as criticising the co-op program because I think they do a really good job. But what is most important about the program is the attitude that the students learn towards work rather than the job training they get.

[He adds] You can only buy 70% of a person's effort. The rest has to come from them, and it is in that area that the schools should concentrate, and it's something maybe only they can do.

John Stephenson - Engineer

John Stephenson is in his mid-thirties and works as chief engineer for a company that builds specialised equipment used in forestry. The company is part of a group based in the North, but operates independently, designing and building its own machines. The factory is small (around 100 employees), the product high cost and the output low. Each machine being assembled on the shop floor has already been ordered by a particular customer, and some are individually designed to order.

John Stephenson offers several perspectives on science education--as a practising engineer as an employer, as a parent, and as a teacher (he teaches evening classes at junior college). For this reason, his views are presented here at some length.

As An Engineer

A native of New Jersey, John graduated from Stevens College in the late fifties:

When I graduated there was a sudden demand for engineers. It was the time of Sputnik, and it seemed there wasn't just a demand for engineers, but that we were entering a Technological Society, in which people saw no limit to what you could do with machines, or an engineering approach to problems.

Since then, of course, there has been a total change in climate. We've seen the growth of the environmental and ecology movements, and people now feel that perhaps technology has got out of hand. The enthusiasm for engineering has cooled off.

How did the cultural climate of the late fifties affect the kind of engineering education John received?

When I trained as an engineer I attended what was purely a science college with no liberal arts course. Maybe we had an hour of Shakespeare one Wednesday afternoon, nothing more. As a result we had a very narrow background. We were trained to join a closed society of engineers.

This kind of specialist education had a number of consequences; especially, John feels, for those like himself who had gone to college straight from high school and actually had little idea what engineering was like. Their motives derived as much from success in high school as from any sense of personal destiny. Not surprisingly, many dropped out; and of those who graduated, not a few remained confused about their future careers. They were engineers because the education system had carried them along to the point of graduation, rather than from any sense of personally controlled internal momentum.

John admits that his education disoriented him to some extent, but now he is critical of his education for much more significant reasons. Having established himself as a practising engineer (an identity that is very important to him), he feels that his specialist education was in many ways inadequate. It was based on a set of ideas and values about the nature of engineering that, in turn, was derived from the climate of the "technological society." One way this showed itself was in the strong academic bias of the teaching he received:

> *The professors who taught us were academics, not practising engineers. They might teach you the theory for designing a set of gears, but they would never have had to make such a thing themselves, and they didn't know what to do when the production department said, "That'll cost $300 to produce, and you've got to do it for $30."*
>
> *So the tendency was for us to want to stay in the system when we graduated, because we were frightened of those kinds of practical questions, or just didn't know how to handle them. We took PhD's and taught the same theories to another batch of students. Or we went out to work for the big companies like Lockheed, where they'd maybe have a thousand engineers and you would be able to specialise, and to some extent be protected from more basic questions.*

John feels that one effect of the student unrest of the sixties has been to break the circle by which academics simply replicated themselves on college faculties. While not condoning every aspect of campus unrest, he feels the important questions the students raised were questions about the curriculum, and that in doing so they were voicing many of his own concerns and those of his contemporaries:

> *The students kept asking for <u>relevance</u>, that was the keyword of the sixties, and I think they were mostly right when they said a lot of what you learned in college was irrelevant and bore no relationship to what happened out there in the real world.*

John feels that, to some extent, he has had to work against his training in order to become the kind of engineer who works with real world problems. Most of this has come with experience; but he has ventured back into formal education, completing a law degree in evening school.

From his contact with local universities, John feels there are signs of change, and that higher education is beginning to respond in some way to the experience of his generation. Through professional association meetings he has met the chairman of the engineering school of one of the state colleges. It seems this school is actively trying to recruit practising engineers to the faculty, and is also offering the students more general courses in economics and business studies. (In part this is probably a result of the recent downward trend in the employment of specialist engineers, rather than what John would like to see, which is a strengthening of professionalism amongst engineers.)

The distinction between specialisation and professionalism is an important one, and one that in the past we may have often confused. John clearly feels they are not mutually dependent, but argues strongly for decreased specialisation alongside increased professionalism. He would, for example, like to see an intern system for engineers similar to that in medicine. Part of the difficulty in establishing such a thing is the lack of a system of professional licensing for engineers, which means that it is not easy to press for higher professional standards. His dual training in engineering and law has recently taken John into courts as a professional witness, and he sees one possible outcome of the growing number of law suits being filed against engineering companies for such things as design faults, being the kind of professional organisation that might make it possible to enforce higher standards. While he is committed to the development of professionalism amongst engineers, this does not necessarily imply specialisation, just as the country doctor may be no less professional than the brain surgeon.

As for decreasing specialisation, John prefers to work in a small company, "where you can see the design through to the finished product," and compares his situation favorably with that of a colleague who works for Lockheed in Atlanta.

> *He'll spend perhaps a year designing one bolt to hold the tail flaps of an aircraft he'll never see. Here I may be the only person who knows what the finished thing will look like. That brush cutter we were looking at--that's my baby. When we built the prototype I was down on the shop floor with a wrench in my hand. And when we went out into the woods to test it, I went too. Doing that you often see things that are obviously wrong or badly designed, but which you wouldn't notice just sitting at a drawing board.*

Of course there are constraints, some of which would no doubt overwhelm the academic or large company director. The plant has no facilities for metal casting or for working with glass fibre or plastics, and John talks enviously of the computing facilities available in some places. Yet he sees constraints, even severe ones, as the essence of the design engineer's job. "That's what the job is. Working within the limits of the situation and producing something that works even if it isn't the ultimate machine."

Talking as an engineer, his main criticism of education is that it is too often theoretical and academic, and not concerned enough with the value questions and the social and environmental considerations which he feels should be of greater importance to anyone working in the applied sciences. Most of this criticism is aimed at college level education, but he'd like to see the schools operate with more of a problem-solving, or project-based approach, once students have acquired the basics. He is aware of curriculum experiments along these lines, but feels they have had very limited effect outside a few well known schools.

John is strongly in favor of the introduction of widespread metrication, and feels it should be done suddenly rather than gradually, for "in the long run a rapid change would be easier." He quotes the example of when Denmark changed from driving on the left to on the right. "They closed the roads for two hours, and then at midnight everyone changed over. It was the only way to do it. That's the way we should approach metrication. It would be better in the long run."

As An Employer

The company, like many companies in the South, lives with the advantages and disadvantages of being non-unionised. The main advantage that John sees is not in terms of lower wage rates, but in terms of the flexibility of labor. Men can be moved from one job to another when there is a rush to complete an order, and as an engineer he, too, can get his hands dirty when it seems necessary ("in a union plant they wouldn't let me lift a wrench"). The biggest disadvantage is the availability of a ready pool of skilled labor. The turnover rate is low and many employees are part-time farmers (working hours are 7:00 a.m. to 3:30 p.m., so that they have a few hours daylight after work). But welders especially tend to be transient workers and are often hard to recruit. The state runs courses to try to meet demand, but this requires a degree of long-term planning the economics of the industry rarely allows.

More generally, John feels that there are deep-seated trends that perhaps the education system should address. Like Mr. Ward, he is concerned with the schools as a source of attitudes toward work. To some extent this is revealed in his view of the professional

engineer; but he also has strong views about craftsmanship:[3]

> *I regret that we have lost respect for the craftsman in America. At home I have a family Bible. It was the first Bible printed in America, in 1790. At the back there is a list of the names of the people whose subscriptions made the edition possible. First there is "George Washington, President." Then follows a list of people who were "sailmakers," "cabinet-makers," "shipwrights," and so on. It seems to me that people were proud of what they did then, and they used their craft like we might use our degrees or professional qualifications. In some ways I regret that change. If my son says to me: "When I graduate from high school I want to be a machinist, and I don't want to go to college!" I don't think he should feel ashamed about it, nor should I. But that kind of change in attitude seems a very difficult one to make. Inside schools or outside there seem to be a lot of pressures on the old idea of craftsmanship.*

Pecan County is still far enough from contemporary industrial society for people to remember the old values. People repeatedly referred me to the Foxfire books, and sometime during my stay in the area I came across some reference or evidence of most of the skills these books describe. Many people shared the misgivings John Stephenson so eloquently expressed of an attitude toward life that scarcely survives in these days of interstate highways, television and supermarkets. Children, too, seem deeply conscious of the past. One junior high school student told me his favorite school subject was history, and his favorite TV programmes, "The Waltons" and "Little House on the Prairie:"

> *I'm just real interested in the old days. I like to talk to my Granny about the old days and how things were. How they used to walk five miles to school, and what they used to eat and what they used to wear.*

Paradoxically, nostalgia for the pioneer past seems to make it easier to forget the more recent past, pre-Civil Rights, adding a twist to William Faulkner's comment that, "in the South the past is not dead, in fact the past is not even past."

It seemed to me that it was often the people who expressed a feeling of loss about the past who were in some way at the current cutting edge of the society. John, the industrial engineer in a rural area, was one. The junior high school student who avidly watched "The Waltons" was another. A black boy who lives "out in the woods" all the year but who spends the summer with his sister in New York City. His adolescent experience is probably beyond the imagination of most of us, not only many of his teachers.

On John's point about the decline of craftsmanship, it is important to note that many who share his concern feel the argument is economic as much as social. There is considerable public concern about the cost of higher education at state level. The injection of state money has created an expansion of institutions that has had considerable effect on those towns blessed with universities and colleges. However, questions are now being raised about the educational quality of many of the courses. In a state where only some 20% of the high school graduates proceed to college there might seem to be room for expansion; but there seems at present to be considerable concern about the high cost of a system which, as one person put it, "produces PhD's in Home Economics who can't bake cornbread." The competition between the public schools and higher education for funds was, during the period of the study, beginning to emerge as a crucial issue.

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[3]However hard I try, I cannot bring myself to write "craftspersonship." Any alternatives would be welcome.

As A Parent

John has two children in the city public school system. A boy in seventh grade, a girl in fourth grade. On the whole he is impressed by the quality of the schooling they receive:

> *I am especially impressed by the new math they get. My kids understand the basic number system much better than I ever did at their age. They understand about tens and units and they know for instance what multiplication is, rather than just knowing some tables by heart. In the long run I'm sure this will be a big advantage to them, especially when they come to take algebra or calculus.*

John sees the math program as an acceleration of the curriculum he received at school rather than fundamentally different in kind:

> *In the seventh grade they are considering unknowns, exponentials and basic geometry. Even in fourth grade they have done equilateral triangles--concepts I didn't meet in school until the tenth grade.*

He sees one reason for this in the improved training of math teachers. "When I was in school it was always a joke that the physical education teacher or the coach taught math in his spare time. It wasn't really taken seriously like it is now."

One thing that does trouble him is the ease with which he sees his son turn to the pocket calculator. ("I hate to see them use it so early.") The danger is that children will stop thinking about the processes involved. He would much rather they were taught to use a slide rule before going on to the calculator. "With a slide rule you've got to know where you are and what you are doing. You've got to have a rough idea of the answer, if only to place the decimal point. And as you operate it, you can see what you are doing and how some of the things work: in the addition of logs, for example. It's not a black box like the calculator."

This response might seem strange from a practising engineer whose working day involves some dependency on the calculator, but John sees a clear distinction between the world of school and the world of work in this respect:

> *Here, the answer is important. I have to be sure I have it right. In school, getting the right answer is secondary and less important than how you got there.*

As A Teacher

John offers another perspective on the educational scene because he is also a teacher. Each morning he teaches a class in basic engineering to plant employees, but in addition he teaches math, and sometimes science, at junior college night school classes.

He feels confident teaching math. The course is "basic and organised around what people want to know rather than around a textbook." Biology he found rather more difficult. "The courses have changed so much since I was a student. I don't think we went much beyond the cell at high school, but now my son in seventh grade knows all about mitochondria and the finer structure of the cell." Nevertheless, the course did give John the chance to try relating science to day-to-day things. He felt many of the students didn't realise how immediate science is to much of their daily lives; instead they saw it as distant, abstract

and difficult. He gave the example of local concern over a plan to introduce chlorination of water supplies. John explains, "There was a lot of confusion; people didn't understand such things as the relationship between chlorine and ordinary salt. They thought, 'Chlorine is a poisonous gas, someone is trying to poison us all.'"

Summary

Like Preston Ward, John Stephenson sees the school's role as critically concerned with developing certain attitudes and values amongst students, rather than as concerned with a purely instructional process. At this point their views probably diverge; Mr. Ward seems to be looking to the schools for people who can apply themselves persistently to routine, if difficult tasks. John Stephenson, on the other hand, seems to be looking to the schools for people who will question what they are doing, not simply in terms of means, but also in terms of ends.

Perhaps the major problem met by the school curriculum as it attempts to move from instruction to values is how to cope with the values of a society increasingly conscious of its pluralism. How far the views represented by Mr. Ward and Mr. Stephenson are compatible, and how far they conflict, is not only a question for the schools, but a question of more general significance. Should schools be concerned with meeting the kind of labor needs a plant like Mr. Ward's demands? Should they attempt to raise the aspirations of students, knowing they will be compromised? Or should they forget such questions altogether and just get on with the business of teaching?

These questions, which raise themselves in the gaps between the world of school and the world of work, are perhaps amongst the most critical curriculum questions of all. They are not questions that can be answered within any one curriculum area, any more they can be met by the schools alone.

IF ONLY I'D HAD MORE TIME

As a family we enjoyed our seven-week stay in Pine City immensely; but there's a lot I didn't get to see, people I didn't get to talk to, classes I didn't get to visit. Some of those I did get to don't figure in this report when perhaps they should.

The biggest gap is the elementary schools. I spent most of my time in the high schools because that's where I started, and even after six weeks there were still things I wanted to do. Nevertheless, some of the most interesting and the most skillful teaching I saw was in first grade. It doesn't figure here because I ran out of time and space and found it difficult to organize within the format of this report. It doesn't mean I don't think it was important.

The same is true of those teachers who let me into their classes but who are not reported here. Their omission might be perceived as criticism or as a slight. It isn't intended to be. I value what I saw in their classes just as much as what I report, but in trying to compress everything into a manageable space I chose to sacrifice coverage for detail. It was almost chance who and what was included and what was excluded. If I were to do it all again, it might come out differently. . . .

Currently a lecturer at the University of East Anglia, Rob Walker is a former teacher for the Inner London Education Authority who has also been a research fellow with the Centre for Science Education, Chelsea College, University of London, and a lecturer at the University of Keele.

His research has included work in the fields of pharmacology and sociology, as well as in education. Other projects in which he has participated include the Classroom Research Project at the Centre for Science Education, Chelsea College (1970-72), and SAFARI (Success and Failure and Recent Innovations)--a project affiliated with the Centre for Applied Research in Education at the University of East Anglia (1973-76).

Rob lives in Norwich, England, with his wife, Lynne, and their two children. As the accompanying photo reveals, he has a penchant for highly symbolic behavior and totally lacks a sense of humor. His publications include Guide to Classroom Observation (with C. Adelman, 1975) and Changing the Curriculum (with B. MacDonald, 1976).